

BULLETIN 154

MAMMALS OF THE ISLANDS IN  
THE GULF OF ST. LAWRENCE

BY  
AUSTIN W. CAMERON

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NATIONAL MUSEUM OF CANADA  
DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES









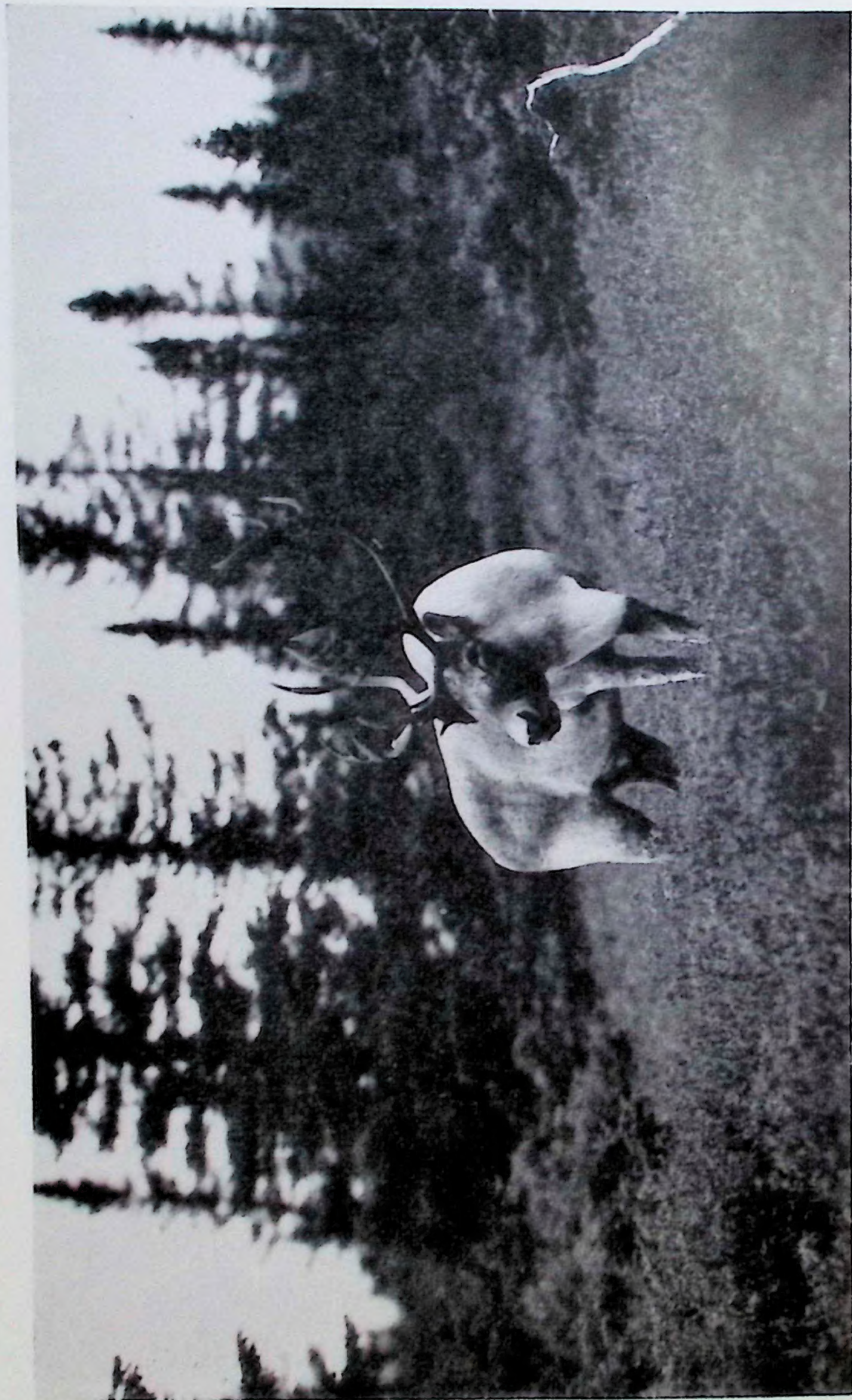












Newfoundland Caribou

—Photo courtesy Nfld. Dept. Mines and Res.



CANADA  
DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

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MAMMALS OF THE ISLANDS IN  
THE GULF OF ST. LAWRENCE

BY  
Austin W. Cameron

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# THE MAMMALS OF THE ISLANDS IN THE GULF OF ST. LAWRENCE

## INTRODUCTION

The present paper is a report on a study of the terrestrial mammals occurring on the islands in the Gulf of St. Lawrence—Newfoundland, Anticosti, the Magdalens, Cape Breton Island, and Prince Edward Island. The project was undertaken primarily in an attempt to obtain first-hand up-to-date information on the mammalian faunas of the islands, which heretofore has been scanty and often inaccurate. Only one island, Anticosti, had previously been visited by a zoologist, who subsequently published a report on his studies, while the available data on the others have been confined to brief observations or purely taxonomic studies. That so little should be known about the mammals of readily accessible areas in the Temperate Zone, visited or settled by the white man for over three centuries, is surprising and probably can be attributed to a number of factors.

Chief among these factors, perhaps, was the prevailing notion that the islands had been adequately studied faunistically. It is true that there were many explorers interested in animal life who visited the islands and reported on what they found there. But by modern standards their investigations were very superficial and limited in value to the biologist of today. Certainly data that would seem superfluous to these early investigators are of the utmost importance now in determining the ecology, distribution, and taxonomy of the species in question.

Possibly another factor is that of timing. When mammalogy became a recognized branch of zoology in its own right, eastern North America had been settled for almost three centuries, and much was already known about its fauna. By contrast, vast regions of the north and west were scarcely explored and seemed to offer much greater opportunities for field zoologists. As a result, expeditions were organized to study the faunas of the prairies, the west coast, and the Arctic, and consequently the East was neglected. It is not surprising, therefore, that the Gulf of St. Lawrence region and Ungava are, mammalogically, among the least known parts of North America today.

Serious students of evolution and zoogeography probably disregarded the islands in the Gulf of St. Lawrence because of their proximity to the mainland and rather recent land connections. Problems of endemism and significant changes in ecology were not expected on continental islands, so recently severed from the mainland. In so regarding these islands, however, zoologists overlooked the fact that although the islands are of recent origin geologically, they are rather unusual in that three of them undoubtedly have had no post-glacial land connections and no refugia existed during glaciation where mammals might have survived. It follows therefore that the present mammalian fauna is derived from mammals that

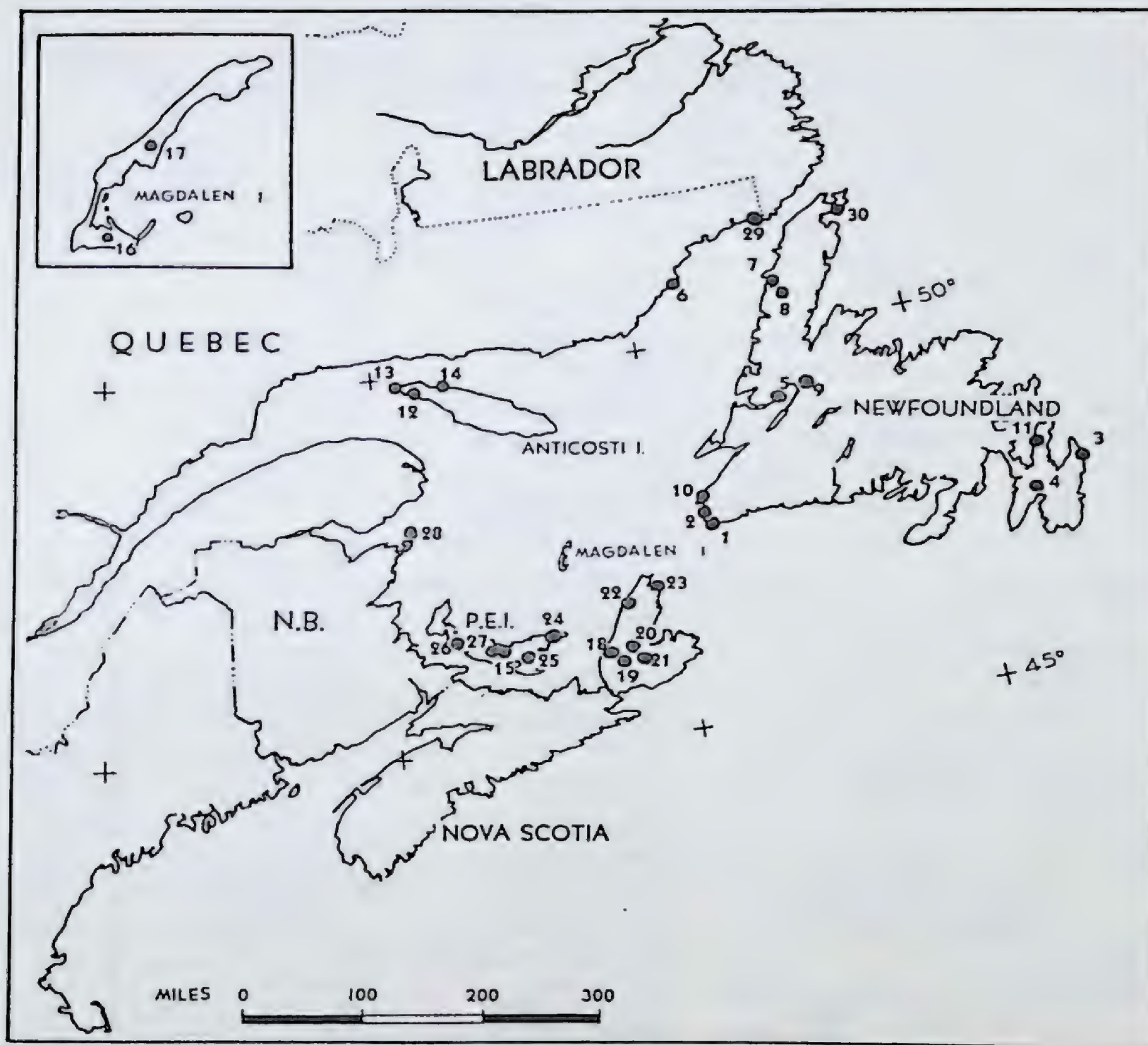


were obliged to cross the water barrier, resembling in this respect the faunas occurring on oceanic islands. Furthermore, proximity to the mainland probably led many to suppose that the species composition on the islands was essentially like that of the mainland and that there was very little opportunity for well-differentiated forms to evolve. The fact that no less than twelve endemic races, some of them well defined, occur on the three northern islands attests to the effectiveness of the straits separating the islands from the mainland, as barriers to mammalian dispersal. The combination of rather recent glaciation, the separation of some of the islands before the retreat of the ice, and the effectiveness of the barriers that restricted colonization, has resulted in a group of insular faunas of biogeographical interest exceeded only by those occurring on oceanic islands.

The present study embraces the following topics:

1. The number of native and introduced species occurring on each island and their numerical status and distribution;
2. Data on the mammals occurring on the neighbouring mainland, in order to make direct comparisons with the species occurring on the islands;
3. A taxonomic study of the native species, whenever possible, and a re-evaluation of the validity of named forms, and the describing of new forms where necessary;
4. A consideration of the possible barriers restricting the distribution of mammals in the region, with special reference to the straits separating the islands from the mainland and from one another;
5. A consideration of the past history of the islands in terms of glaciation, changes in land level and possible land connections, and the ways in which these factors have affected the dispersal and distribution of mammals in the region;
6. The northward spread of mammals into Eastern Canada following the retreat of the ice, with respect to the species that arrived first in the region after it became habitable as opposed to those that were late arrivals (the approximate order of arrival in Eastern Canada, it was thought, could be inferred by the present distribution, particularly with regard to the species that reached the islands and those that did not);
7. A consideration of the means by which mammals succeeded in reaching the islands, based on a study of such factors as ocean currents, floating ice, floating debris, vegetated moraines;
8. An attempt to determine the site of origin on the mainland of the insular species, based on morphological similarity between the insular races and those occurring on the mainland;
9. The effects of changes in ecology in response to a new environment, particularly to one in which there are unfilled ecological niches and fewer competitive species.





Map showing collecting localities. (See page 4 for locality list)

It was, of course, not possible to investigate every aspect of these problems exhaustively, and in many cases it has been possible to draw only general conclusions on the information available. Ecological studies, particularly with regard to changes in habitat preferences and the nature of inter-relationships in a community consisting of a smaller number of species than normally occur together on the mainland, are yet to be carried out. Questions of the role played by inter-specific competition in habitat selection, food habits, and other supposed species characteristics can perhaps be resolved by studies in insular populations where the species number is small, the inter-relationships are simple, and competition for ecological niches is less keen.



## FIELD INVESTIGATIONS

Seven field seasons, totalling almost two years, were devoted to collecting and observing mammals in the Gulf of St. Lawrence Region. The following is a list of the areas visited and the periods spent in each:

| Year | District                  | Localities                             | Periods spent in area | Map Legend |
|------|---------------------------|----------------------------------------|-----------------------|------------|
| 1949 | Newfoundland.....         | Port aux Basques....                   | June 1-3; 6-7         | 1          |
|      |                           | Tompkins.....                          | June 3-5              | 2          |
|      |                           | St. John's.....                        | June 8-11             | 3          |
|      |                           | Salmonier.....                         | June 11-22            | 4          |
|      |                           | South Brook.....                       | June 23-Aug. 19       | 5          |
| 1950 | Quebec North Shore.....   | La Tabatière.....                      | June 13-26            | 6          |
| 1950 | Newfoundland.....         | Port Saunders.....                     | June 28-July 13       | 7          |
|      |                           | Hawke Bay.....                         | July 13-15            | 8          |
|      |                           | Port Saunders.....                     | July 15-25            | 7          |
|      |                           | Junction Brook -<br>(near Deer Lake).. | July 29-Aug. 7        | 9          |
|      |                           | Doyle's.....                           | Aug. 9-Sept. 6        | 10         |
| 1951 | Quebec.....               | Lévis.....                             | May 16-20             | —          |
|      |                           | Trois Pistoles.....                    | May 20-June 12        | —          |
|      | Gaspé Peninsula.....      | Gaspé.....                             | June 13-18            | —          |
|      |                           | Cortoréal.....                         | June 18-July 18       | —          |
|      | Newfoundland.....         | Grande Grève.....                      | July 18-30            | —          |
| 1952 | New Brunswick.....        | St. John's.....                        | Aug. 11-15            | 3          |
|      |                           | Dildo.....                             | Aug. 15-23            | 11         |
|      | Anticosti Island.....     | Tabusintac.....                        | June 2-7              | —          |
|      |                           | Port Menier.....                       | June 17-19            | 12         |
|      | Gaspé Peninsula.....      | West Point.....                        | June 20-23            | 13         |
|      |                           | Baie Marten.....                       | June 23-July 21       | 14         |
|      |                           | Cascapedia.....                        | July 22-Aug. 27       | —          |
|      |                           | Charlottetown.....                     | Aug. 28-29            | 15         |
|      | Prince Edward Island..... | Amherst Island.....                    | Aug. 30-Sept. 6       | 16         |
|      | Magdalen Islands.....     | Grindstone Island...                   | Sept. 6-8             | 17         |
| 1953 | Quebec.....               | Tadoussac.....                         | May 12-14             | —          |
|      |                           | West Mabou.....                        | May 20-June 30        | 18         |
|      | Cape Breton Island.....   | Brook Village.....                     | July 1-15             | 19         |
|      |                           | Nevada Valley.....                     | July 15-31            | —          |
|      |                           | Aberdeen.....                          | Aug. 1-10             | 20         |
|      |                           | Bucklaw.....                           | Aug. 6-17             | 21         |
|      |                           | Cheticamp.....                         | Aug. 17-21            | 22         |
|      |                           | Cape North.....                        | Aug. 21-23            | 23         |
|      |                           | Souris.....                            | May 27-June 29        | 24         |
|      |                           |                                        | July 5-17             | 25         |
| 1954 | Prince Edward Island..... | Georgetown.....                        | June 29-July 5        | 26         |
|      |                           | Kensington.....                        | July 18-20            | 27         |
|      |                           | Hunter River.....                      | July 20-28            | 28         |
|      |                           | Miscou Island.....                     | Sept. 15-21           | —          |
|      |                           | Trois Pistoles.....                    | June 11-20            | —          |
|      | New Brunswick.....        | Blanc Sablon.....                      | June 29-July 4        | 29         |
|      | Quebec.....               | St. Anthony.....                       | July 5-8              | 30         |
|      | Quebec North Shore.....   | Cartwright.....                        | July 10-24            | —          |
|      | Newfoundland.....         | Nain.....                              | July 29-Aug. 15       | —          |
|      | Labrador.....             | Northwest River....                    | Aug. 18-22            | —          |
| 1955 | Newfoundland.....         | Cartwright.....                        | Aug. 23-Sept. 8       | —          |
|      |                           | St. John's.....                        | Sept. 11-14           | —          |
|      |                           | Indian Cove.....                       | Sept. 26-Oct. 4       | —          |
|      |                           |                                        |                       | —          |



## BIOGEOGRAPHICAL SIGNIFICANCE OF INSULAR POPULATIONS

For our understanding of the mechanics of speciation, the adaptations which living organisms can make to a new environment, and the importance of competitive species in altering the course of evolution of emerging species, biographers owe a great debt to islands and their isolated populations. The most dramatic and revolutionary change in biological concepts arose from island studies conducted by Darwin (1860) on the Galapagos Islands and by Wallace (1859) on the islands comprising the Malay archipelago.

The discovery by these naturalists that remote islands and island groups often have distinctive animal and plant species led to the discovery that isolation is indeed the prime prerequisite to evolution. Despite all attempts by dissenters to show that species can arise in populations in close contact with other closely-related populations with which they can freely interbreed, it is still conceded by most biologists that isolation of one form or another is absolutely necessary before speciation can occur.

Genetical studies, unknown at the time of Darwin and Wallace, have revealed the cytological mechanisms by which speciation is possible. The discovery that the gene is the vehicle by which characters are transmitted from parent to offspring and that, through mutation, new characters can be introduced into the population, has made it possible to understand why populations inhabiting islands are likely to diverge from the parent populations and why speciation on islands is likely to be rapid.

The results of genetical studies have shown that in a freely inbreeding population there is an even distribution of genetic variability of the species with the result that speciation is impossible. But if a small part of the population becomes isolated, such as on an island, any variability that might subsequently arise is confined to the population in which it appeared. Furthermore, the smaller or daughter population is unlikely to possess the same genetic composition as the parent population even at the time when the separation occurs. A small sample is likely to lack the rarer mutations present in the larger population from which it was derived, and, by the same token, any rare alleles present in the original population may occur at a much higher frequency in the small population. Such rare mutations may either increase or decrease with each succeeding generation in the small population, although there may be little change in the parent group. Given a sufficient number of generations, the daughter population may diverge to such an extent that its members can no longer freely interbreed with those of the parent population, and a new species is established (Dobzhansky, 1951).

Isolation of populations can be spatial, temporal, or physiological. Spatially, populations can be isolated geographically or ecologically, a separation that differs more in degree than in kind. Temporal isolation exists where two or more populations occupy the same area but breed at different times of the year (Schnakenbeck, 1931). Physiological isolation is a term applied to the many innate factors that prevent breeding between individuals belonging to two populations.



Spatial isolation is the most important of the three, since it is highly probable that it must exist before other forms of isolation can become effective (Mayr, 1942). Isolation such as is found in island faunas is of the spatial or geographical type. The water barrier separating the island from the nearest land mass is the actual isolating factor, but a topographical feature that constitutes a barrier to one species may in no way restrict the movements of another. Expanses of water which are impassable to small mammals or land snails may present no problem to birds or flying insects. Furthermore, the effectiveness of a stretch of water as a barrier is not wholly dependent on its breadth, since the direction of the prevailing winds, the nature of the ocean currents, and the presence or absence of floating ice may render an otherwise navigable strait impassable, or vice versa.

Island faunas are generally depauperate in genera as compared with those of the nearest land mass from which they were derived. This may either be due to the fact that the animals were obliged to cross a water barrier to colonize the island, or that there existed, for a short time only, a land bridge which was utilized by some species but not by others. Simpson (1940) calls the first a "sweepstakes" route, because colonization by this means is at best accidental, while the second he calls a "filter bridge," because it admits many of the mainland species but excludes certain others. He uses the term "corridor" to refer to a land connection of long standing across which any species present in the general area may pass. It is axiomatic that the more formidable the barrier between island and mainland, the fewer the species which will succeed in crossing it. It is therefore to be expected that islands far removed from the mainland will have fewer mammal species than those separated only by narrow straits. It is also to be expected that a small island will have fewer species than a large one, because there are likely to be fewer ecological niches.

Because the islands in the Gulf of St. Lawrence are located on the continental shelf of North America and are therefore separated from the mainland by narrow straits, one would hardly expect many endemic forms to arise. Most islands located on the continental shelf have had rather recent land connections, and therefore their faunas are usually identical with those of the nearby mainland. That such a situation does not exist in three of the five larger islands in the Gulf is due to the fact that they probably have had no post-glacial land connections. It is therefore incorrect to regard them as continental islands in the sense proposed by Mayr (1942), although it would be equally incorrect to designate them "oceanic islands," which, however, they rather closely resemble zoologically. For the purposes of the present discussion, therefore, they might be designated "post-glacial islands" to differentiate them from the other two types.

Briefly, the three northern islands in the Gulf—Newfoundland, Anticosti, and the Magdalens—differ mammalogically from the neighbouring mainland in that more than 50 per cent of the mainland species are absent and at least one order and three families are unrepresented. On the other two, Cape Breton Island and Prince Edward Island, which probably have had land connections within the last 12,000 years, no less than four species



are absent. It might be said that the mammals which have colonized the three northern islands were admitted by means of a sweepstakes route, while a filter bridge existed in the case of the southern islands.

Elsewhere in this paper the factors responsible for the differences that exist between the mammalian faunas of the islands and those of the neighbouring mainland are discussed in detail.

The types of barriers that have isolated these populations are also discussed at considerable length.

## COMPARISON OF ISLANDS IN THE GULF OF ST. LAWRENCE WITH OTHER ISLAND GROUPS

As has been mentioned previously, none of the islands in the Gulf of St. Lawrence has a mammalian fauna as rich in species as the neighbouring mainland. In Cape Breton Island and Prince Edward Island, the number of native species is only slightly less than that of peninsular Nova Scotia and New Brunswick. But the three northern islands—Newfoundland, Anticosti, and the Magdalens—have less than 50 per cent of the species occurring in the adjacent mainland. A list of the species, by islands, is given in Table I.

As is evident from this, even the two southern islands lack at least four species—the raccoon, striped skunk, woodchuck, and porcupine. In the "Discussion" this subject is treated at some length, and it is concluded that these species were late arrivals to the region and therefore unable to take advantage of the land bridges that probably connected the islands with the mainland.

Turning to the three northern islands, the most conspicuous differences between their mammalian faunas and that of the mainland is the complete absence of moles and shrews and the scarcity of rodent species. It is also remarkable that most of the carnivores occurring on the mainland also occur on the five islands. This suggests that they were early arrivals to the region (Matthews, 1952).

The species composition of many islands, even those lying on the continental shelf, differs from that of the adjacent mainland. As the British Isles and the Japanese Archipelago lie roughly in the same latitude, they have been chosen for comparison with the Gulf islands. The British Isles, like the Gulf islands, were almost completely glaciated by the fourth or last ice-sheet and, too, some of them were connected to the mainland by a land bridge since the retreat of the ice.

Considering first the British Isles, it is worthy of note that while England has thirty-seven species, Ireland has only sixteen. The insectivores are poorly represented, while on the three northern Gulf islands they are absent. The carnivores are quite well represented, but Ireland has only one species of small rodent as compared with the seven occurring in England. Again, there is a parallel with the northern islands where only one species of small rodent occurs on Newfoundland and Anticosti. Ireland has several endemic races, as is true of the Gulf islands.



TABLE I

Mammals Native to the Islands in the Gulf of St. Lawrence<sup>1</sup>

|                             | Peninsular<br>Nova Scotia | Cape Breton | P.E.I. | Nfld. | Anticosti | Magdalens |
|-----------------------------|---------------------------|-------------|--------|-------|-----------|-----------|
| Cinereous Shrew.....        | x                         | x           | x      |       |           |           |
| Smoky Shrew.....            | x                         | x           | x      |       |           |           |
| Saddle-backed Shrew.....    | x                         |             |        |       |           |           |
| Water Shrew.....            | x                         | x           | ?      |       |           |           |
| Pigmy Shrew.....            | x                         | x           | x      |       |           |           |
| Short-tailed Shrew.....     | x                         | x           | x      |       |           |           |
| Star-nosed Mole.....        | x                         | x           | ?      |       |           |           |
| Little Brown Bat.....       | x                         | x           | x      | x     | x?        | ?         |
| Long-eared Bat.....         | x                         | x           | ?      | x     | ?         | ?         |
| Red Bat.....                | ?                         | ?           | ?      | ?     | ?         | ?         |
| Hoary Bat.....              | x                         | ?           | ?      | ?     | ?         | ?         |
| Snowshoe Hare.....          | x                         | x           | x      |       |           |           |
| Arctic Hare.....            |                           |             |        | x     |           |           |
| Woodchuck.....              | x                         |             |        |       |           |           |
| Chipmunk.....               | x                         | x           | x      |       |           |           |
| Red Squirrel.....           | x                         | x           | x      |       |           |           |
| Flying Squirrel.....        | x                         | x           | x      |       |           |           |
| Beaver.....                 | x                         | x           | x      | x     |           |           |
| Deer Mouse.....             | x                         | x           | x      |       | x         | x         |
| Wood Mouse.....             | x                         |             |        |       |           |           |
| Bog Lemming.....            | x                         | x           | ?      |       |           |           |
| Red-backed Mouse.....       | x                         | x           | x      |       |           |           |
| Meadow Mouse.....           | x                         | x           | x      | x     |           | x?        |
| Muskrat.....                | x                         | x           | x      | x     |           |           |
| Meadow Jumping Mouse.....   | x                         | x           | x      |       |           |           |
| Woodland Jumping Mouse..... | x                         | x           | x      |       |           |           |
| Porcupine.....              | x                         |             |        |       |           |           |
| Wolf.....                   | x                         | x           | ?      | x     |           |           |
| Red Fox.....                | x                         | x           | x      | x     | x         | x?        |
| Black Bear.....             | x                         | x           | x      | x     | x         |           |
| Raccoon.....                | x                         |             |        |       |           |           |
| Pine Marten.....            | x                         | x           | x?     | x     | x         |           |
| Fisher.....                 | x                         | ?           | x      |       |           |           |
| Ermine.....                 | x                         | x           | x      | x     |           |           |
| Mink.....                   | x                         | x           | x      |       |           |           |
| Striped Skunk.....          | x                         |             |        |       |           |           |
| Otter.....                  | x                         | x           | x      | x     | x         |           |
| Cougar.....                 | x                         | x           |        |       |           |           |
| Lynx.....                   | x                         | x           | x      | x     |           |           |
| Bobcat.....                 | x                         | x           |        |       |           |           |
| White-tailed Deer.....      | x                         | x           |        |       |           |           |
| Moose.....                  | x                         | x           | x      |       |           |           |
| Caribou.....                | x                         | x           | x?     | x     |           |           |

<sup>1</sup> For the definition of the term "native" see page 12. Queries indicate that the species is unrecorded for the areas in question, but probably occurs, or has occurred. The symbol "x?" indicates past or present occurrence, but there is some doubt that the species is native to the area.



A similar condition is apparent when the mammalian fauna of the Japanese Archipelago is compared with that of the adjacent mainland. Fifty-two species (exclusive of bats and insectivores) occur in northern China, Manchuria, and Korea, while only twenty-six are native to Japan. Here again there is a scarcity of rodent species, while most of the mainland carnivores occur on the Archipelago. The insectivores of Korea and Manchuria are very imperfectly known, but there are numerous species. Only six are recorded for Japan. Differentiation has occurred in the Japanese populations, and five endemic species and a rather large number of subspecies are recognized (Carter, Hill, and Tate, 1945; Tate, 1947).

Parenthetically, it might be pointed out here that a study of various islands and island groups reveals that, in general, the greater the stretch of water separating an island from the mainland or other islands, the fewer the species of mammals occurring on it. New Guinea has fifty-seven mammalian genera; New Britain and New Ireland which lie seaward from it each have eighteen; the Solomons have fifteen; while Santa Cruz, the most remote in this island chain, has only five (figures compiled from Carter, Hill, and Tate, 1945).

Because conditions in the British Isles closely parallel those of the Gulf islands, it seems desirable to treat the subject of mammalian dispersal in that region in some detail. The last glacial age in the British Isles came to a close about 20,000 years ago, and the post-glacial period is taken as extending from that time. For some time after the retreat of the ice, the region consisted chiefly of tundra across which wandered large herds of reindeer, long since extinct. The gradual warming up resulted in the development of extensive forests of birch, followed by pine and hazel. Undoubtedly similar conditions obtained in the Gulf islands following the retreat of the ice. About 15,000 years ago there were considerable changes in the sea-level because of the sinking of the land, as shown in raised beaches in various parts of the British Isles. As will be pointed out elsewhere in this paper, there is similar evidence for such changes in land level in the southern Gulf of St. Lawrence. The Straits of Dover were cut off about 7,000 years ago. If a land bridge connected Cape Breton and Prince Edward Island, it is probable that the straits were formed about that time, or perhaps somewhat earlier. When the Straits of Dover cut off the British Isles, the fauna was essentially like that found today, except for those species which have since become extinct.

All except the southernmost part of England was ice-covered during the last glaciation, and since the climate must have been sub-arctic, it is doubtful if many mammal species could have survived in the region (Matthews, 1952; Deevey, 1949).

Since the Straits of Dover finally separated Britain from the mainland only 7,000 years ago, it is remarkable that a number of endemic races occur on the mainland of the island as well as on several of its coastal islands. Matthews (1952) concludes that for some time the isthmus may have been so narrow that many continental species had difficulty finding it. Many writers have doubted that 7,000 years is sufficient time for a new subspecies to arise, especially such well-marked forms as the British squirrel. A similar question has arisen with regard to the subspecies



occurring on the islands in the Gulf of St. Lawrence, which could not have been isolated for more than 12,000 years when the ice is believed to have retreated from northern Newfoundland and Labrador (Antevs, 1931). However, it should be noted that the Faeroe house mouse (*Mus musculus faeroensis*) has apparently evolved within the last 500 years (Degerbøl, 1940), and the endemic races of birds in Scandinavia have probably arisen within the last 10,000 to 15,000 years (Mayr, 1942). Genetic changes can evidently arise in a very short period, such as the differentiation of insecticide-resistant flies and the industrial melanism of moths within a few decades (Goldschmidt, 1940). The suggestion that these British races differentiated *before* the last ice-sheet pushed southward and migrated to the continent during glaciation seems untenable, according to Matthews (1952).

The mammals with the widest distribution in the British Isles are those which are believed to have arrived first, such as the pigmy shrew and most of the carnivores. By the same line of reasoning, it seems probable that the black bear, otter, marten, and deer mouse were early arrivals to the islands in the Gulf of St. Lawrence. Matthews points out that in Britain the water and common shrews must have been late arrivals because of their restricted distribution. In the present study, it is concluded that the woodchuck, raccoon, striped skunk, and porcupine must have been late arrivals to Eastern Canada, because they are absent from all five islands. Possible land connections in the British Isles are postulated on the basis of morphological similarity between the races of several species, such as the occurrence of the same subspecies of stoat (*hibernica*) on the Isle of Man and in Ireland (the islands of Jura and Islay have their own subspecies, *ricinae*). It is suggested that the Isle of Man was connected by a land bridge to Ireland after the isthmus between Ireland and southern Scotland disappeared. Since Cape Breton Island and Prince Edward Island have no endemic races and since the same subspecies that occur on the neighbouring mainland also occur on these islands, it seems highly probable that they have had relatively recent land connections.

It is difficult to apply the same line of reasoning to the distribution of British rodents, because several subspecies occur on small coastal islands where there are no carnivores. Matthews points out that it is hard to understand why the rodents reached these islands, and the carnivores did not, since the carnivores are thought to have been early arrivals. However, the carnivores may have colonized the islands but failed to survive because the rodent population was too low to maintain them. He considers transportation by floating timber, etc. as not very convincing. He points out further that these rodents must have colonized these islands at the earliest possible moment after glaciation and before the islands were cut off from the mainland. That this is not necessarily true is evident from the present study since the mammals of the three northern islands could not have invaded the islands by means of land bridges, as apparently none have existed in post-glacial times.

It is interesting to note that the subspecies of red deer occurring in the British Isles is almost a barren-ground race, adapted to the poor conditions on the fringe area of the species. There seems to be a striking



parallel with the barren-ground beaver of Newfoundland, discussed elsewhere in this paper. This deer is descended from a larger forest-living species now extinct.

Matthews concludes that, considering the short time that has elapsed since the last glaciation, it is difficult to find a satisfactory explanation to fit the facts of the occurrence and present distribution of subspecies among British mammals. It may be accounted for by assuming that the islands were populated shortly after the retreat of the ice and, when their connections to the mainland were severed, differentiation was perhaps possible. The same problem presents itself with regard to the Gulf of St. Lawrence mammals as is discussed elsewhere in the paper, but here the matter is further complicated by the paucity of definite geological information and the likelihood that no post-glacial land connections have existed between Newfoundland, Anticosti, the Magdalens, and the neighbouring mainland. It seems possible only to conclude that subspeciation must proceed at a more rapid rate than heretofore supposed.

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### THE MAMMALIAN FAUNA OF THE ISLANDS

The Mammalian fauna of each island is treated as a distinct unit in each of the following five sections: Cape Breton Island, Prince Edward Island, Anticosti, the Magdalens, and Newfoundland. Each species is considered separately, with comments on distribution, numerical status and ecology, and, where applicable, taxonomy. The specimens listed are those in the National Museum of Canada collection, except where otherwise stated.



Since the terms "endemic," "native," and "introduced" have not been standardized, the following definitions are included here to indicate the sense in which they are used in the present paper:

*endemic*: an animal that has evolved on an island or in a region and that does not occur elsewhere, e.g., the Newfoundland black bear is endemic to Newfoundland.

*native*: an animal indigenous or occurring naturally on an island or in a region, as opposed to being introduced, but not necessarily confined to the region, e.g., the red fox is native to Anticosti.

*introduced*: an animal brought to an island or region by man, either voluntarily or inadvertently, e.g., the snowshoe hare and Norway rat are introduced species in Newfoundland.

The distribution of most of the species is indicated on maps at the end of the paper. Other distributional information is given in the text.



## THE MAMMALS OF CAPE BRETON ISLAND

Cape Breton Island, which is politically a part of the province of Nova Scotia, lies roughly between 45 and 47 degrees north latitude in the southeastern sector of the Gulf of St. Lawrence. It has a length of approximately 100 miles and an average width of about 45 miles, with the long axis running in a general northeast-southwest direction. The land surface area is approximately 3,975 square miles.

The mile-wide Strait of Canso separates it from peninsular Nova Scotia, the nearest land mass. An 80-foot-wide causeway, completed in 1955, connects the highways and railroads on the Island with those on the mainland. Previously, strong tidal currents from the Gulf of St. Lawrence to the north and the open Atlantic to the south swept through this narrow gut.

Geologically, the Island is a part of an up-tilted and eroded surface of a cretaceous peneplain which dips below the Atlantic on the east and rises gradually to the north and west to form hills of over 1,200 feet elevation. The west coast is characterized by precipitous cliffs or "capess," in many places rising vertically from the sea-shore, with few bays and inlets. By contrast, the east coast is highly irregular with numerous indentations formed by the drowned valleys.

The highlands consist of an elevated plateau occupying the northern third of the Island, most of which now lies within the boundaries of Cape Breton Highlands National Park. Hills of more than 600 feet elevation also flank the Bras d'Or Lakes and run inland from the west coast in a series of ranges running roughly parallel to the long axis of the Island. These uplands consist chiefly of igneous rocks, syenites, diorites, and granites.

The lowlands in the southern sector of the Island are of Carboniferous age and consist of sandstones, shales, conglomerates, limestone, and gypsum. There are numerous precipitous cliffs and deep valleys, many with broad intervals. Streams are numerous, but lakes and ponds few. Lake Ainslie is the only large freshwater lake.

The whole area was glaciated, and it is probable that local glaciers formed on the tops of the higher hills and spread outward, possibly covering the eastern half of Prince Edward Island (Prest, unpublished). It is probable that the entire region subsided in post-glacial times and that a land bridge connected island and mainland shortly after the retreat of the ice. The subject of changes in land- and sea-level in the region is discussed elsewhere in this paper.

The climate of the island is equable with a mean temperature of 42.3 degrees Fahrenheit and a range of -25 to 98. The average temperatures for the four seasons are as follows—January: 22.1; April: 36.3; July: 63.6; October: 48. The southern part of the island has 140 frost-free days compared with one hundred days for the northern highlands. Fog occurs more frequently on the east coast where there are thirty foggy days as compared with ten for the west coast. The average annual precipitation is 40.4 inches (Climatic Summaries for Selected Meteorological Stations, Meteorological Division, Department of Transport, Canada, 1954).



Botanically, Cape Breton Island lies within the Acadia Forest Region, in which red spruce (*Picea rubens*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), yellow birch (*Betula lutea*), red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), red pine (*Pinus resinosa*), white pine (*Pinus strobus*), and white ash (*Fraxinus americana*) are common trees (*Native Trees of Canada*, 1955). Sugar maple is found on the better-drained soils, beech on the drier ridges, and red maple in swampy places and along lake borders. In poorly drained or exposed areas, the dominant trees are balsam fir and red spruce, while larch and black spruce occur in the bogs and swamps (Roland, 1945).

#### MAMMALIAN FAUNA

Although Cape Breton Island has a richer mammalian fauna than any of the larger islands in the Gulf of St. Lawrence, it nevertheless lacks at least four species: the raccoon, striped skunk, woodchuck, and porcupine. Perhaps the relatively large number of species can be attributed to its proximity to the mainland of Nova Scotia.

As is pointed out elsewhere in this paper, there is quite good zoological and geological evidence for supposing that the island has been connected to the mainland by a land bridge in post-glacial times. This seems probable in view of the fact that practically all of the shrews and the smaller rodents are native, a condition not generally found on islands that have not had previous land connections. The presence, also, of most of the reptiles and amphibians occurring on the mainland and about half of the fresh-water fishes, is further evidence. Convincing geological evidence for post-glacial land subsidence makes a postulated land bridge seem quite possible.

While the habitats on the island are very similar to those occurring over most of peninsular Nova Scotia, it is surprising that a number of common mainland species are scarce on the island, or are subject to violent fluctuations in numbers. There appears to be no satisfactory explanation for the scarcity of chipmunks, deer mice, and ermine on the island.

The recent construction of a causeway connecting island and mainland provides a means whereby the species now absent on the island can gain access. At least three species, the raccoon, skunk, and woodchuck, are likely to colonize the island within the next few years, if they have not already done so.

#### PREVIOUS WORK

Prior to 1953 no comprehensive study of the mammals of the Island had been carried out, and heretofore no complete account of the species occurring in the area had been published. Except for one collecting expedition, no serious attempt has been made to obtain a representative series of mammals.

In 1953, a National Museum of Canada field party consisting of Victor E. Gould and W. Earl Godfrey collected in the Cape North, Frizzleton, and St. Peters areas during the period August 17 to October 25, inclusive. The fine series collected has proved most useful in the present study.



Dr. R. M. Anderson, formerly mammalogist at the National Museum of Canada, and C. H. Young, of the same institution, visited the northern highlands and collected in the Ingonish area from September 26 to October 19, 1924. Dr. Anderson again visited the area briefly in 1928. The material they collected on the barrens provided information on the mammal distribution in a habitat not often visited by collectors.

In 1941, Dr. C. H. D. Clarke spent part of August and September in the National Park, during which time he made mammalogical observations, particularly with regard to the big game animals and fur-bearers. The results of his study were published in mimeographed form by the Canadian National Parks Bureau in 1942. Included is a list of the mammals collected by Dr. Anderson.

Ronald W. Smith, in his paper on the land mammals of Nova Scotia (1940), gives records of each species by county, including Cape Breton Island. Data on the number of big game and fur-bearing animals are published annually by the Nova Scotia Department of Lands and Forests. These have proved extremely helpful to the writer in the preparation of the present paper. Dr. A. L. Rand has compiled and analysed the data applying to the fur-bearers for the period 1932-1942 (1944).

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#### ACCOUNTS OF SPECIES

##### **Maritime Cinereous Shrew.** *Sorex cinereus acadicus* Gilpin

*General.* This shrew is common and frequently abundant in a wide variety of habitats throughout the island. Open, mature mixed woods with an abundance of rotting vegetation and leaf litter on the forest floor appear to be the most favoured areas. Woodlands where the ground is moist, but not soggy, yielded higher trapping returns than dry upland woods. Two specimens were taken in an overgrown pasture within 12 yards of a second-growth spruce woods.



The number of shrew specimens taken varied in relation to the density of other small mammals in the area. When the *Peromyscus* population is high, fewer shrews are trapped, but as the deer mice are trapped out, the shrews are taken in greater numbers. This would seem to indicate that when the mouse population is high, they tend to enter the traps before the shrews have had an opportunity to do so. The types of bait used can also influence the ratio of deer mice to shrews. Peanut butter seems to be most effective in trapping mice, while bacon fat, either in raw strips or rendered, attracts more shrews.

*Specimens.* Victoria County: Cheticamp Lake 5; Ingonish Centre; Camp Point, Flat Barren, 1; edge of Northern Barren, 1; Cape North, 7; Richmond County: St. Peters, 1; Bucklaw, 4.

*Distribution in Region.* See Distribution Map No. 1.

**Northern Smoky Shrew.** *Sorex fumeus umbrosus* Jackson

*General.* A single specimen, the first recorded for the Island, was taken on June 23 at West Mabou, Inverness County, along the edge of a second growth spruce wood bordering on overgrown pasture.

*Distribution in Region.* See Distribution Map No. 2.

**Acadian Water Shrew.** *Sorex palustris gloveralleni* Jackson

*General.* A single specimen was collected on a sandy bar in a small stream 2 miles southwest of Brook Village. The stream flowed through a mature woods consisting chiefly of mixed spruce and maple. The forest floor was damp, and various species of mosses formed a covering; numerous well-rotted logs along the stream's edge probably provided adequate shelter. Another was observed by the writer at Smithville, Inverness County, on August 19, 1954.

*Specimens.* Victoria County: Cheticamp Lake, 1; South Ingonish, 1; Ingonish Centre, 1; Inverness County: Brook Village, 1.

*Distribution in Region.* See Distribution Map No. 3.

**Maritime Pigmy Shrew.** *Microsorex hoyi thompsoni* (Baird)

*General.* One specimen was collected by Dr. R. M. Anderson at Ingonish Centre, Victoria County, on October 17, 1924.

**Northeastern Short-tailed Shrew.** *Blarina brevicauda pallida* R. W. Smith

*Taxonomy.* *B. b. pallida* is paler than any of the *Blarina brevicauda* group. Specimens from peninsular Nova Scotia, especially those from the southwestern part of the province, have pale grey undersides marked with brown, while the Cape Breton Island specimens exhibit none of the brownishness on the belly. The Cape Breton specimens also have slightly darker (more fuscous) upper parts. Skulls of *pallida* are indistinguishable from *talpoides*, but the Cape Breton specimens have a slightly narrower interorbital constriction.

*General.* In Cape Breton, as elsewhere, this species appears to be rather local in distribution. In the course of trapping on the mainland the writer has found that in certain fairly well-defined areas this shrew



may be so abundant that practically no other species of small mammal are taken. In another area, which appears almost identical with regard to vegetation types, soils, moisture, etc., it may be totally absent. Thus it appears that in the Maritime Provinces, at least, *Blarina* occurs in relatively small, isolated populations, well separated from one another, and that, further, where such populations exist, there are few other small mammals. It is possible, of course, that the scarcity of other species is more apparent than real and that the low trapping returns are due to the fact that the short-tailed shrews enter the traps first. On the other hand, this species is aggressive and might well tend to replace other species.

Although *Blarina* occurs in a wide variety of habitats, it seems particularly partial to the dryer habitats of deciduous woods, especially if the canopy is open and sufficient sunshine reaches the forest floor to permit the growth of various grasses and herbs. Often open grassy areas within a deciduous or mixed deciduous-coniferous woods yield the highest trapping returns. Specimens have also been taken in heavy, mixed deciduous-coniferous woods, if there is a considerable depth of leaf mould. And occasionally quite high densities occur in alder thickets, provided the ground is not excessively moist.

No heavy densities were found in Cape Breton, but it is interesting to note that in an area near Aberdeen, where two short-tailed shrews were taken, only a single red-back was secured.

From time to time, semi-albinos are taken. It appears that if the animal is injured and a part of the skin removed, the subsequent pelage will lack pigment.

*Specimens.* Victoria County: Ingonish Beach, 1; Ingonish Centre, 6; Inverness County: Nevada Valley, 1; Aberdeen, 2; Bucklaw, 2.

*Distribution in Region.* See Distribution Map No. 5.

#### **Star-nosed Mole.** *Condylura cristata nigra* Smith

*General.* Uncommon on the Island, occurring chiefly in the interior valleys. Reports of this species were received from Mabou, Glencoe, and River Denys.

*Specimens.* Inverness County: Frizzleton, 1; Upper Margaree Valley, 2.

*Distribution in Region.* See Distribution Map No. 6.

#### **Little Brown Bat.** *Myotis lucifugus lucifugus* (LeConte)

This species is relatively common throughout the island, especially in the interior valleys near streams and marshes where nocturnal flying insects are abundant. Weather conditions had an important bearing on the number of flying bats observed during the course of the summer. During the period spent by the 1953 field party on the island, there was heavy precipitation, and only four flying bats were observed. However, an estimated population of about forty bats were found in the attic of a house near Little Judique, Inverness County. The house was visited on May 30, and one immature bat about 10 days old was collected. Because of the many exits from the attic, no adults were secured.



There are no natural caves in Cape Breton to provide hibernating quarters. Presumably the bats hibernate in buildings and hollow trees.

*Records.* Inverness County: Cheticamp, 1; Little Judique, 1 immature; Victoria County: Cape North, 1 (specimens). Sight records from Inverness County: Port Hood Island, Port Hood, Whycocomagh, Aberdeen, Inverness, Cheticamp.

**Keen's Long-eared Bat.** *Myotis keenii septentrionalis* (Trouessart)

*General.* Records would seem to indicate that this bat is uncommon to rare, but large numbers have been taken in a single locality on a few occasions (Smith, 1940). Further collecting will probably establish this species as being much commoner than present records would indicate, because the writer has taken it to the north in Newfoundland.

*Specimens.* Victoria County: Cape North, 2.

**Nova Scotia Snowshoe Hare.** *Lepus americanus struthopus* Bangs

*General.* The snowshoe hare presumably reached a peak in abundance on the island about 1948, followed by several years of marked scarcity. The population was still low in the summer of 1953, but a rapid increase has been apparent since then, and reports received in the winter of 1955-56 indicate a fairly high density. Presumably another peak year can be expected about 1958.

Although the cyclic fluctuation in this species has been described as synchronous throughout its range, examination of the available data reveals as much as two years' difference in the peak and low years between central and eastern Nova Scotia (including Cape Breton Island). The following table, showing years of marked scarcity and abundance between 1932 and 1943, has been compiled from information published by Chitty and Elton (1933 to 1942) and Chitty (1946):

|                                | <i>Peak Abundance</i> | <i>Greatest Scarcity</i> |
|--------------------------------|-----------------------|--------------------------|
| Cape Breton Island .....       | 1938-39               | 1932-33<br>1942-43       |
| Eastern Nova Scotia .....      | 1938-39               | 1932-33<br>1942-43       |
| Central Nova Scotia .....      | 1940-41               | 1934-35                  |
| Isthmus of Chignecto .....     | 1940-41               | 1934-35(?)               |
| Southwestern Nova Scotia ..... | 1939-40               | 1933-34                  |

It is interesting to note that declines occurred in these instances on the periphery of the range in Nova Scotia and subsequently spread inland. The same phenomenon was observed by the writer in the declines of the ruffed grouse (*Bonasa umbellus*) in Nova Scotia (Cameron, 1949).

Considerable variation in density presumably exists even in separate localities in the Maritime Provinces, as the writer found hares fairly abundant on the Grand Manan archipelago in 1945 but scarce on Cape Breton Island. The density on the archipelago was estimated as at least four times greater than on Cape Breton Island (Cameron, 1945a).



It was found that between 1932 and 1940, the years of great scarcity occurred in both the snowshoe hare and the grouse within a year or two of one another. A low in the hare cycle occurred in the winter of 1932-33, and the period of greatest scarcity in the ruffed grouse occurred in 1934. Ten years later (the winter of 1942-43) hares were again in the trough of their cycle, and the grouse cycle dipped to its lowest point in 1944. It is unfortunate that figures on the cyclic changes for the hare are not available prior to 1938. However, the writer has compiled all available information for the ruffed grouse, and it appears that lows occurred in that species in the province in 1897, 1906, 1917, 1925, 1934, and 1944, an average of 9.4 years per cycle (Cameron, 1949).

It has been observed elsewhere that the grouse cycle generally follows the hare cycle by a year or two, and it was supposed that the grouse exhibited cyclic fluctuations because the predators that previously preyed on the hares were obliged to turn to the grouse when the hares declined in numbers (Leopold, 1933). However, this is now known to be incorrect, since the hares decline in numbers in the absence of a large predator population or heavy hunting pressure.

In peak years, hares occur in a wide variety of habitats, but during a period of decline the population seems to be largely restricted to black spruce swamps. The same is true of cedar swamps in those parts of Eastern Canada where this tree occurs.

*Specimens.* Victoria County: Cape North, 1; Inverness County: Port Hood, 8.

*Distribution in Region.* See Distribution Map No. 8.

#### **Eastern Chipmunk.** *Tamias striatus lysteri* (Richardson)

*General.* The chipmunk is relatively uncommon on the island and appears to be largely confined to the interior valleys and the lowlands bordering the Bras d'Or Lakes. It was not observed along the coastal areas. In 1953 this animal was observed at Skye Glen, Brook Village, Margaree, and Aberdeen, Inverness County; at Cape North and Baddeck, Victoria County; Grand River, Richmond County; and Mira River, Cape Breton County. Clarke (1942) reports it common in the northern part of the island in 1942. The apparent scarcity of this mammal on the island cannot be attributed to the lack of suitable habitat since there is an abundance of second-growth deciduous woods and overgrown pastures which are favoured by this species on the mainland.

*Specimens.* Victoria County: Cape North, 6; Inverness County: Frizzleton, 3.

*Distribution in Region.* See Distribution Map No. 10.

#### **Eastern Red Squirrel.** *Tamiasciurus hudsonicus gymnicus* (Bangs)

*General.* The red squirrel is common and is widely distributed throughout the island. It occurs along the windswept coastal strips on the coastal islands (Port Hood Island and Scatari Island) where the spruces are stunted by the heavy gales, as well as in the interior valleys. Unlike



individuals on the mainland, it rarely builds leaf nests in the branches of trees. Several such nests were observed near Brook Village, and one was observed at Aberdeen, both inland localities. Probably the strong winds along the coastal areas discourage the construction of these nests.

The spring moult appears to be slow; among island specimens winter pelage is still apparent in June specimens, and a July 24 specimen from Nevada Valley still had winter pelage on the rump and flanks. The autumn moult appears to be more rapid. A Frizzleton specimen collected on September 28 had already acquired winter pelage on the forelegs, while an October 19 specimen from St. Peters had acquired the complete winter coat.

In the past, the red squirrel has been extensively trapped on the island and has provided a welcome additional income to country folk despite the low prices offered for the pelt. Nevertheless, only about 3 per cent of the pelts exported from the province originated on Cape Breton Island. This can probably be attributed to the fact that there are fewer trappers on the island, rather than that there is a significant difference in the squirrel population in the two areas.

*Specimens.* Inverness County: Frizzleton, 4; Brook Village, 2; Nevada Valley, 2; Victoria County: Bucklaw, 1; Cape North, 7; Cheticamp Lake, 1; Richmond County: St. Peters, 5.

*Distribution in Region.* See Distribution Map No. 1.

#### **Nova Scotia Flying Squirrel.** *Glaucomys sabrinus gouldi* Anderson

*General.* This species is apparently very local in distribution on the island. Ten specimens were taken in a single area less than an eighth of an acre in extent during an eight-day period in late June; repeated attempts to secure specimens elsewhere in similar habitat failed. Nevertheless, during the winter months trappers often take these mammals in traps set for weasels and mink.

The area in question was located along a small brook flowing through a mature spruce forest on the west coast of the island about 2 miles southwest of the hamlet of West Mabou. The large number of hollow trees scattered throughout the woods probably made the area attractive for *Glaucomys*. Because of the shielding canopy of the mature spruces, the forest floor consisted only of a deep layer of spruce needles and decaying tree trunks and stumps. This appears to be the type of habitat preferred by this species.

Interestingly enough, all ten specimens collected were males. Since the females have dependent young during the month of June, it is probable that they do not travel as extensively as the males. The life-history of this species is largely unknown, and it is not known, therefore, whether the males tend to have larger home territories than females.

*Specimens.* Inverness County: Frizzleton, 3; West Mabou, 10.

*Distribution in Region.* See Distribution Map No. 1.



**Acadian Beaver.** *Castor canadensis acadicus* Bailey and Doult

*General.* According to early reports the beaver originally was widely distributed throughout the island, but by 1869 it was absent from all of the province east of Port Medway, Queen's County (Hardy, 1870). Between 1937 and 1944 five introductions of beaver were made to the island. In 1937, four animals were released at North River, Victoria County; in 1938, nine were released near Ingonish in the Cape Breton Highlands National Park; in 1944, three were liberated at Tillard River, Richmond County; and two at Northwest Brook (River Ryan), Cape Breton County. Three further releases were made on the island in 1952.

Although many of the streams on the island are fast-flowing and therefore unsuitable for beaver, the released animals have increased and spread out from the original sites. In the Ingonish area, the animals released in 1938 required several years to become established, but from 1941 onward a gradual increase was noted (Cameron, 1945b). Poplar (*Populus* sp.), the favourite food of this rodent, is uncommon in the Park area but is quite plentiful in river valleys in the central and southern parts of the island. In some cases the writer found that the beaver, rather than construct lodges and dams to live in, used bank burrows, because the violent fluctuations in the water-level of the fast-flowing streams on the island made them difficult to dam.

Dr. A. S. MacLaren (pers. comm.) reports that beaver dams were observed in 1954 at Lake of the Islands, north of the Clyburn Brook, in the National Park.

The Nova Scotia Department of Lands and Forests in sponsoring the sale of all beavers taken in the province thus facilitates the control of illegal trapping and also provides a more accurate count of the numbers taken annually.

*Distribution in Region.* See Distribution Map No. 11.

**Maritime Deer Mouse.** *Peromyscus maniculatus abietorum* Bangs

*General.* Deer mice were uncommon in the summer of 1953, if trapping returns can be relied upon as a criterion, and they were apparently scarce in northern Inverness and Victoria counties in 1935, according to Gould (1935). Anderson (1942) did not collect any in the National Parks area in 1924. The writer during nine years collecting in the Port Hood area did not find it so abundant as the red-backed mouse (*Clethrionomys gapperi*), although collecting on the mainland would seem to indicate that it is generally more abundant than the red-back. The factors responsible for this scarcity are not readily apparent. There appears to be an abundance of suitable habitat, and it would seem only natural that a high population would be attained. There is no evidence that the low population can be attributed to the abundance of predators, as ermine and buteo hawks are both less abundant than on the mainland. It must be admitted that most of the available information is based on collecting for two summers only and in one small coastal area over a nine-year period. It is possible that *Peromyscus* had population lows in 1935 and 1953, as they



are known to be cyclic to a certain extent. In 1953, of course, the weather was unfavourable, and there is no doubt that the catches were smaller than otherwise would have been the case.

In Eastern Canada, deer mice prefer rather dry upland mixed woods, preferably where there is an abundance of leaf litter and other decaying vegetable matter. Traps set adjacent to prostrate logs yielded the best results, but those set on the tops of these logs were found to be almost as productive (Cameron, 1953).

It seems significant that only one specimen of deer mouse was taken on Prince Edward Island in 1954 and that the population density was relatively low on Anticosti in 1952. By contrast, a total of 42 specimens were taken by the writer during a four-week period spent on the Gaspé Peninsula in 1951.

*Specimens.* Inverness County: West Mabou, 3; Frizzleton, 1; Margaree Island, 1; Victoria County: Cape North, 7.

*Distribution in Region.* See Distribution Map No. 12.

**Cooper's Lemming Mouse.** *Synaptomys cooperi cooperi* Baird

*General.* A rare species in Nova Scotia; only 14 specimens have ever been collected in the province. The single Cape Breton Island specimen was taken by R. M. Anderson on a bog near Cheticamp Lake, Victoria County.

*Distribution in Region.* See Distribution Map No. 13.

**Nova Scotia Red-backed Mouse.** *Clethrionomys gapperi pallescens* Hall and Cockrum

*General.* Red-backed mice were uncommon in Cape Breton in 1953; only 18 specimens were collected in the ten-week period devoted to field work. It is possible that this species never reaches the densities observed on the mainland, which would account for the apparent scarcity, although even under apparently optimum conditions, fluctuations do occur throughout the range of the species. These oscillations, however, show no marked periodicity such as is evident in *Microtus* or *Dicrostonyx*, where three- to four-year cycles have been recorded. But it is impossible to be dogmatic on this point, because no single population of *Clethrionomys* has been studied over a sufficiently long period to establish for certain that no regular fluctuations occur within such a population. Lack of uniformity in population oscillations throughout the range of a species do not preclude the possibility of periodicity in each individual population. And, in the experience of the writer, this species is not uniformly distributed throughout its range; rather, numerous small aggregations occur within a limited area surrounded by wide expanses where the density is extremely low or where the species is actually absent. This being the case, it is very possible that any intrinsic factor that might tend to decimate one of these "isolated" populations would be unlikely to spread to neighbouring communities, thus accounting for lack of uniformity in population changes. There is ample evidence (Matthews, 1952) that most small mammals are segregated into



discrete communities or demes even within a habitat that appears to be uniformly favourable. Parasitological studies of *Microtus* indicate that this situation occurs in that species. Only further long-range studies of *Clethrionomys* both in insular and mainland habitats will reveal the nature of its population dynamics.

In Cape Breton, *Clethrionomys* has similar habitat preferences to those observed on the mainland, and observations made there agree with data obtained by the writer in New Brunswick and eastern Quebec. In the course of trapping small mammals, it is only natural that a considerable volume of information on the habitat preferences of such an abundant species should accumulate. From such studies it is evident that *Clethrionomys* reaches its highest densities in sub-climax mixed woodlands with an understory of ferns and herbaceous plants and a forest floor covering of leaf litter and other decaying organic matter. It is further evident that optimum conditions include the presence of water either in the form of springs, streams, ponds, or standing water as is found in swamps. Dry upland woods that otherwise meet all requirements rarely have high populations. Tanner (1950) in his study of the red-back found that few individuals occur more than 300 yards from available water, and in the laboratory their water requirements were very high compared with most other small species.

Slightly less favourable are open, mixed mature woods with an abundance of rotting leaf litter and sufficient smaller plant growth to provide shelter. Again the situation tends to be moist. However, wooded areas where the ground is perpetually soggy are rarely frequented by this vole.

Often an old slashing, grown up to young maple, birch, and spruce, still having the remnants of brush piles, will support a fairly high population. Generally this situation exists in overgrown slashings which lie adjacent to, or are surrounded by, sub-climax mixed woods where the vole population is at a high level. The population in the slashing would appear to be an overflow from the nearby woods where a strong population pressure has built up. Many of the specimens taken were immatures, presumably spreading out from centres of abundance and seeking new territory.

Trap yields from the shrubby borders flanking grasslands or overgrown pastures are occasionally large, especially when the population is high in the adjoining woodland, of which the border forms a fringe. Along this transition or "edge" (Leopold, 1933), *Microtus* may also be abundant in peak years, but the two never appear to occupy the habitat simultaneously. This suggests that these intermediate zones between grassland and woodland are occupied by one species or the other, depending upon the density of the species in question. What happens when both species are at a peak level and therefore subject to population pressures from their respective territories, remains to be determined. Observations made by the writer in Newfoundland strongly suggest that *Microtus* is restricted on the mainland to grassland habitats because of competition with *Clethrionomys*, since it occurs throughout the woodlands, as well as meadows, in Newfoundland. If this is true, then it is probable that the red-back occupies the shrubby habitat during peaks in its abundance regardless of



the density level of the meadow vole, and the latter probably occurs here only during peak periods when the habitat is not occupied by *Clethrionomys*.

While the home territories of red-backs vary considerably in extent, depending upon the suitability of the habitat and population pressure, the average size, according to Tanner (1950), is approximately 0.20 of an acre.

In Eastern Canada, *Peromyscus maniculatus* often occurs in the same habitat with the red-back, but it is more partial to dryer terrain and possibly to deciduous rather than coniferous woods, to which *Clethrionomys* is apparently partial. It should be noted, of course, that the term "habitat preference" is misleading, since the habitat occupied in many carefully studied species is often the one in which the species can successfully compete with closely related forms and not necessarily the one that would be selected if it had a "choice." This is well brought out in the studies of *Microtus* in Newfoundland and the Magdalen Islands by the writer, and of the Arctic Hare in Newfoundland, chaffinches in the Canary Islands, and the hares in Ireland (Lack, 1944).

Possibly the deer mouse and the red-back actually occupy different ecological niches, as the deer mouse is partially arboreal while the red-back is strictly a ground-level inhabitant. Food habits vary considerably: the deer mice consume large quantities of insects during the summer months, while the red-back feeds sparingly, if at all, on these animals (Hamilton, 1941). Also, the deer mouse stores sizable quantities of grass and other seeds and feeds also on mast, while the red-back appears to utilize conifer seeds as well as succulent roots, lichens, and fungi. It is possible, therefore, that they do not compete seriously for food, although they occupy virtually the same territory.

Other species that occupy the same territory are *Sorex cinereus*, *Tamiasciurus hudsonicus*, and to a lesser extent *Blarina* and *Napaeozapus*.

Specimens of this vole were taken at West Mabou along the steep bank of a wooded ravine where small spruce, birch, and mountain maple formed an almost impenetrable tangle. Traps set along half-rotted tree trunks lying deep in sodden moss were the most productive. In Nevada Valley, the edge of an old slashing adjoining an open mature spruce and pine forest proved the most productive area. A low, very wet hardwood with numerous surface springs yielded only one specimen and a few cinereous shrews. At Bucklaw the wooded slopes flanking a swift mountain stream proved reasonably good, but the low population was rather surprising.

*Specimens.* Inverness County: West Mabou, 5; Brook Village, 3; Nevada Valley, 6; Frizzleton, 7; Victoria County: Bucklaw, 4; Cape North, 13; Ingonish Centre, 3; Northern Barren, 4; Cheticamp Lake, 1; Richmond County: St. Peters, 5.

*Distribution in Region.* See Distribution Map No. 1.



**Acadian Meadow Mouse.** *Microtus pennsylvanicus acadicus* Bangs

*General.* Meadow mice were relatively scarce in the summer of 1953, although the abundance of runways in the fields and meadows indicated that a much higher population had been present in the recent past. According to reports obtained from the farmers in the area, these voles were abundant in the summer of 1952 and appeared to remain at a high level throughout most of the winter. This would suggest that 1952 was a peak year and that a crash in numbers had occurred some time before June 1953. Although the population may have remained at a high level during the late summer and early autumn, it is very possible that a decline had already set in by late summer. Chitty (1952) found that 1937 was a peak year in meadow voles in Britain but that before August there was an excessive juvenile mortality so that the young did not replace the adults which have a short life span and tend to die off in early autumn. Some juveniles of the summer did survive, but they did not breed until the following spring. When the population is on the upswing, however, breeding continues throughout most of the winter. From his study he concluded that mortality is due to severe intraspecific strife, which affects the hormonal balance of the females to such an extent that young produced during this period lack normal vitality and are more susceptible to disease. It is interesting to note that declines in ruffed grouse are also the result of juvenile mortality (Edminster, 1947), and here again stress seems to be basically responsible for declines. Similar observations have been made on snowshoe hares (Green and Evans, 1940).

As the writer has never observed any period when the fields were "over-run" with meadow mice, such as is frequently reported from the mainland, it is possible that population densities do not appear to reach such high levels on Cape Breton as on the mainland. Possibly the general scarcity of meadow mice and other small mammals accounts for the apparent scarcity on the island of rodent-eating predators, such as buteo hawks and ermine. On the other hand, as Prince Edward Island seems to have had a number of serious outbreaks of meadow voles, it is unwise to conclude that the islands are not subject to such violent fluctuations as the neighbouring mainland. Newfoundland, on the whole, appears to have a uniformly lower mouse population (Pimlott, pers. comm.), but Tuck (pers. comm.) found one area in 1951 completely riddled by mouse burrows and runways.

Since much of Cape Breton Island is still uncleared, the total area of field and meadowland on the island is probably less than 30 per cent in contrast to Prince Edward Island, which is 85 per cent cleared. As the cleared areas in Cape Breton tend to be small and scattered, it is quite possible that the *Microtus* population never gets an opportunity to attain high densities such as are possible in large tracts of unbroken grassland.

All specimens secured were taken in low meadows or damp hay fields with little local variation in distribution. Meadow mice, however, did appear to be more abundant in the interior valleys and along the Bras d'Or Lakes than on the open, windswept fields along the coast. Old runways were found on the edges of several bogs, but no current occupation was obvious and no specimens were taken in such situations.



Even where there are large tracts of uninterrupted grassland, there is some evidence that the entire area is not uniformly populated by meadow voles. Here and there throughout the tract, dense aggregations occur with intervening areas where few or no mice occur. Dr. T. W. M. Cameron (pers. comm.) in his study of *Microtus* endoparasites found that specimens taken from one population may be heavily infested with one parasite, while others, taken only several hundred yards away, may be completely free of the parasite but infested by another form. These findings would seem to indicate the almost complete absence of contact between the two populations. It would not greatly surprise the writer if we were to discover, after a careful study of some of our native rodents, that the population as a whole consists of discrete populations that are almost completely isolated from one another.

*Specimens.* Victoria County: Cape North, 17; Ingonish Centre, 4; Ingonish Beach, 4; Northern Barren, 3; Cheticamp Lake, 3; Bucklaw, 8; Inverness County: West Mabou, 1; Aberdeen, 1; Frizzleton, 3.

*Distribution in Region.* See Distribution Map No. 14.

#### **Eastern Muskrat.** *Ondatra zibethicus zibethicus* (Linnaeus)

*General.* The muskrat is the most abundant fur-bearer on the island (excluding the red squirrel). The shallow estuaries of the brooks and rivers flowing into the Bras d'Or Lakes are especially favourable for this species, but suitable habitat also exists in such river valleys as those of the Margaree, Aspy, Middle, and Mabou. And in the smaller marshes and ponds throughout the lowlands a few muskrats are also found, as well as in ponds on the smaller islands off the coast, such as Port Hood Island. In all cases where high densities occur, cattail (*Typha*) is abundant (Errington, 1948).

The 1953 field party observed muskrats near Glen Dyer, Port Hood, Little Judique, Skye Glen, Whycocomagh, River Denys, West Bay, Lake Ainslie, and Cheticamp, in Inverness County; and at Bucklaw, Nyanza, North River, Ingonish, and the Aspy Valley, in Victoria County. In marshes at Grand River and St. Peters, Richmond County, and at Mira Bay and Little Bras d'Or, Cape Breton County, there also are sizable populations.

In the province, the open season for muskrats is generally about six weeks in duration, extending from about the middle of November to the last of December. In 1931 a spring season was opened extending from March 1 to April 30, but the following year an autumn season was declared as it was thought that during a spring season rats were too vulnerable to shooting (Rand, 1944).

Muskrats tend to have a ten-year cycle, according to Elton and Nicholson (1942a), with peak years occurring (for Canada as a whole) in 1912, 1921-22, 1928, and 1930-33, and low years in 1915, 1924-26, and 1934-36. For Nova Scotia, the following are fur returns for the same period:



| <i>Year</i> | <i>Skins</i> |
|-------------|--------------|
| 1912 .....  | 43,000       |
| 1914 .....  | 3,000        |
| 1915 .....  | 12,000       |
| 1917 .....  | 2,000        |
| 1918 .....  | 28,000       |
| 1921 .....  | 22,000       |
| 1924 .....  | 31,000       |
| 1927 .....  | 17,000       |
| 1930 .....  | 46,000       |
| 1932 .....  | 13,000       |
| 1939 .....  | 57,000       |

From the above table it is apparent that peaks probably occurred in 1912, 1918, 1921, 1924, 1930, and 1939. These synchronize fairly well with peaks elsewhere in Canada, but the 1928 peak that occurred in the rest of Canada is not apparent from the fur returns from Nova Scotia, while the Nova Scotia rats appear to have had a peak in 1924 that did not appear elsewhere.

The years 1914, 1917, and 1932 appear to have been low years in the province. These correspond quite well with the rest of Canada, except that 1924 was a low year in most parts of Canada but high in Nova Scotia.

According to fur returns published by the Nova Scotia Department of Lands and Forests, less than 10 per cent of the muskrats exported annually from the province originate on Cape Breton Island.

*Specimens.* Victoria County: Cape North, 31; Inverness County: Port Hood, 2; Richmond County, St. Peters, 2.

*Distribution in Region.* See Distribution Map No. 15.

#### INTRODUCED:

#### **Norway Rat.** *Rattus norvegicus* (Berkenhout)

*General.* This is the common house rat that occurs throughout North America. It is believed to have been inadvertently introduced on this continent from Europe, having been brought there on trading ships from Southern Asia some time after 1750.

High densities of this rodent occur in the vicinity of fishing villages where they feed on fish offal around the wharves and fishing stages. In the late autumn, at the close of the fishing season, they move into nearby dwellings where they constitute a great nuisance as well as a menace to public health.

From time to time reports of "black rats" are received from shipping ports on the island, but as no specimens have been taken, it is not known whether they were melanistic specimens of the Norway Rat, or the black rat, *Rattus rattus rattus*. The latter was recorded in Halifax before 1869 (Gilpin, 1870).



## INTRODUCED:

**House Mouse.** *Mus musculus domesticus* Ratty

*Taxonomy.* The house mice occurring in Canada and the northern United States have been assigned to this race according to Schwartz and Schwartz (1943). It was previously thought that they were referable to the nominate race.

*General.* Widely distributed throughout the island. Generally found in and around dwellings, but occasionally in the woods in habitats similar to those occupied by *Peromyscus*.

**Meadow Jumping Mouse.** *Zapus hudsonius acadicus* (Dawson)

*Taxonomy.* This subspecies occurs in the Gaspé Peninsula, New Brunswick, Nova Scotia, Prince Edward Island, New Hampshire, Vermont, Massachusetts, northern Connecticut, and northeastern New York (Krutzsch, 1954). It intergrades with *canadensis* near Lévis, Quebec, from which it differs in averaging larger, upperparts more ochraceous, sides and flanks more ochraceous and less yellowish, zygomata relatively longer, pterygoid fossa relatively narrower, auditory bulla relatively narrower and usually with a depression on its anterior surface.

*General.* Meadow jumping mice are spotty in distribution throughout most of their range, and specimens are collected only by chance. Only one specimen was taken by the 1953 field party, although additional specimens have been taken on the island by the writer in previous years. They appear rather catholic in choice of habitat, as the writer has taken them in damp meadows, dry uplands, overgrown brush pastures, and occasionally in grassy glades in the woods. They appear to occupy an ecological niche similar to that of *Microtus pennsylvanicus* although perhaps more partial to areas where the vegetation is rank and there is a plentiful sprinkling of shrubs or small trees.

The single specimen was taken in a damp grassy glade in a second-growth spruce woods about 200 yards from an open field at West Mabou.

*Specimens.* Inverness County: West Mabou, 1; Big Intervale, Margaree River, 2.

*Distribution in Region.* See Distribution Map No. 1.

**Eastern Woodland Jumping Mouse.** *Napaeozapus insignis insignis* (Miller)

*General.* The woodland jumping mouse is more specific in its habitat preferences than the meadow species. Most of the specimens secured by the writer in Eastern Canada were taken along the banks of streams or brooks in a wooded area. A dense tangle of shrubs, small trees, grasses, herbaceous plants, and matted vines appears to create the most favourable environment for these mice, although they do venture out into open grassy glades adjacent to such areas. When travelling parallel to the river, they apparently follow along the foot of the bank formed during high water in the spring, as traps set at the base of these elevated banks are usually productive if *Napaeozapus* is in the area.



The six specimens trapped at West Mabou were taken in an open mature spruce woods through which flowed a small stream. Four of the specimens were trapped at the edge of a grassy glade bordering the stream, while the other two were collected fifteen yards from the stream where the ground was covered with spruce needles and a few scattered colonies of shinleaf (*Pyrola*). Seemingly they often travel in areas where there is no plant cover to offer concealment. Ten flying squirrels were taken in the same area.

*Specimens.* Inverness County: West Mabou, 6; Victoria County: Cape North, 1.

*Distribution in Region.* See Distribution Map No. 1.

#### **Eastern Timber Wolf.** *Canis lupus lycaon* Schreber

*General.* The timber wolf has been extinct in Nova Scotia for at least fifty years. According to Warden Roach of the Cape Breton Highlands National Park Service, wolves were present in northern parts of the island around 1850.

Duvar (1867) mentions that the wolf at that time was a rare visitor to Nova Scotia from New Brunswick. Gilpin (1870) states that the wolf "is endeavouring in vain to reinhabit the province. During the last 60 or 70 years they have constantly appeared, single and in pairs, at each extremity of the province, and then have been unheard of for years." He was of the opinion that the last remnant of wolves in the province was centred in the Cobequid Hills not far from the New Brunswick border.

*Distribution in Region.* See Distribution Map No. 16.

#### **Arctic Fox.** *Alopex lagopus* (Linnaeus)

*General.* The Arctic fox has been recorded on Cape Breton Island on two occasions. One was shot at Lingan Bay (near New Waterford), Cape Breton County, on April 10, 1923, by William Ferrow and Neil Boutelier (Devany, 1923). The especially severe winter of 1922-23 may account for the southward migration of this fox, which is uncommon in southern Newfoundland-Labrador and only a casual visitor to Newfoundland. In 1922, however, a sizable migration of this species was recorded in southern Newfoundland-Labrador, and the migration may have continued in 1923.

The second record is that of an Arctic fox captured early in May, 1935, by I. D. Cameron on Port Hood Island. It was kept in captivity until the following November when it was pelted (Cameron, 1950).

Other white fox records from the southern Gulf of St. Lawrence include two from Anticosti reported by Seton (1925). Captain H. W. Walters (pers. comm.) reports that these foxes appear occasionally in northern Newfoundland, but as they have never been seen there during the summer months, presumably they return north.

#### **Northeastern Red Fox.** *Vulpes fulva rubricosa* Bangs

*Taxonomy.* While the red foxes from Cape Breton Island are here referred to *rubricosa*, it should be pointed out that the present population has been derived from the original native stock plus the progeny of



captive foxes released after the decline in fur prices. During the peak years in fur prices, fox raising was not so important an industry in Cape Breton as it was on Prince Edward Island. Though considerable numbers were kept, many were released from captivity with the decline in price between 1930 and 1935. During this period the wild fox population was at a low ebb. Rand (1944) reports that they were very scarce in 1930-31, and although increasing, they continued to be uncommon as late as 1939-40. From 1940 onward they increased steadily and reached a high density on Cape Breton Island in 1951, after which a decline set in. It is evident, therefore, that at the time when the captive foxes escaped or were released, they represented a fairly high percentage of the total fox population on the island. During the years 1936 to 1940, the ratio of silvers (which were economically more valuable and therefore kept in large numbers on the farms) to reds was quite high, probably close to 20 per cent, while silvers now probably represent less than 2 per cent of the total population. The present population therefore is descendant from the native *rubricosa* and the captive foxes, many of which came from western Canada. The taxonomic status of the red foxes now found on the island is, consequently, confused.

This subspecies (*rubricosa*) is rather poorly defined and may prove, upon examination of adequate material, to be untenable. Unfortunately, it is no longer possible to rely on specimens taken in the Maritime Provinces because of the infusion of other races in the present population. Dr. Outram Bangs (1897c) described *rubricosa* as similar in colour to the nominate race with larger skull, broader rostrum, and heavier dentition. Specimens in the National Collection appear to be generally larger than *fulva* but otherwise very similar.

*General.* Although there had been a steady decline since 1951, when the population reached an all-time peak, this species was common in 1953 throughout the settled parts of the island. Up until about 1935 foxes were scarce throughout the island, probably partly because of heavy trapping pressure, as the pelts were much in demand and commanded a good price. From 1936 onward the price declined owing to a change in fashions. By 1950 few foxes were trapped resulting in a rapidly increased population. Data compiled by the Nova Scotia Department of Lands and Forests from 1940 onward indicate a slow increase up to 1943, followed by several years in which the increase was rapid for the province as a whole. Clarke (1942) reported foxes abundant in the Cape Breton Highlands National Park in 1941 which would seem to indicate an even more rapid increase on the island. In 1950 and 1951 they had reached such a high density that they constituted a serious pest to poultry farmers. Efforts were made to reduce their numbers but with little success. Late in 1951 there were indications that a decline had set in. Woodsmen and farmers reported finding carcasses of foxes in an extremely emaciated condition, and farmers observed that the foxes were growing bolder in their attacks on poultry and appeared to be in a weakened condition. By the summer of 1953 far fewer foxes were observed than in previous years, and depredations on poultry were less evident. Farmers estimated that the population in the spring of 1954 was less than half that of 1951.



This species was observed on a number of occasions during the summer of 1953. Dens were located at Nevada Valley, Creignish, and Mabou Harbour, in Inverness County, and near Baddeck in Victoria County. Of the eleven foxes observed, nine were of the red phase and two cross or patch foxes. No silvers were seen, nor were any reported to the writer.

The red fox shows certain indications of a ten-year cycle which appears to be correlated with that of the snowshoe hare, according to Butler (1951). The snowshoe hare reached its peak of abundance on Cape Breton Island in 1948 and 1949 with a decline in 1950 and 1951. Since the decrease in the fox population occurred in 1951 and 1952, a correlation between the two is possible.

Since 1953 the population density on the island has remained relatively stable. It is difficult to predict future fluctuations, but snowshoe hares are increasing and foxes may also show an upswing in numbers.

*Specimens.* Inverness County: Frizzleton, 6.

*Distribution in Region.* See Distribution Map No. 17.

### **Eastern Black Bear.** *Ursus americanus americanus* Pallas

*General.* Although formerly common and widely distributed throughout the island, the black bear, now scarce, is restricted to the wilder parts of the interior mountains. This decline in numbers is largely due to persistent trapping and shooting on the part of sheep raisers who regard the bear as a serious predator. It is interesting to note, however, that despite the decline in the bear population on the island, the annual loss of sheep on range has not lessened appreciably. It is now evident that domestic dogs are largely responsible for sheep losses and that the bear has not played an important role in the destruction of these animals. During the summer months the sheep wander at large on the upland pastures and are not under the direct supervision of the farmer. He may not see them from the time they are released in the spring until they are rounded up for the winter. Failure to recover the entire flock may be due to any number of factors.

Were it not for this program of extermination carried on by man, it is probable that the bear population would attain a high density, as conditions on the island appear very favourable. The slopes of the higher hills are semi-barren and are well vegetated with wild blueberry (*Vaccinium* sp.), which provides an abundance of food in late summer and early autumn. Other wild fruits are plentiful on the abandoned farms and in old slashings during the summer months. At various times of the year, salmon, trout, alewives, and smelts invade the rivers and streams where they are readily available to the bears.

On the basis of reports, it would appear that bears are most abundant in an area extending from the National Park southwest to Lake Ainslie and south to Marble Mountain, Inverness County, and east to St. Ann's Bay, Victoria County. They are tolerably common in the National Park and, according to Clarke (1942), have increased in the area since the Park was established.



Black bears for which bounty was paid were secured by counties as follows (Annual Reports of the Department of Lands and Forests, Nova Scotia):

| —                       | 1941-<br>1942 | 1942-<br>1943 | 1943-<br>1944 | 1944-<br>1945 | 1945-<br>1946 | 1946-<br>1947 | 1947-<br>1948 | 1948-<br>1949 | 1949-<br>1950 | 1950-<br>1951 | 1951-<br>1952 |
|-------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <i>Counties—</i>        |               |               |               |               |               |               |               |               |               |               |               |
| Cape Breton.....        | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             |
| Inverness.....          | 1             | 6             | 2             | 4             | 7             | 3             | 4             | 5             | 3             | 11            | 2             |
| Richmond.....           | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             | 0             |
| Victoria.....           | 0             | 7             | 0             | 4             | 2             | 1             | 2             | 3             | 0             | 1             | 0             |
| Total for Island.....   | 1             | 13            | 2             | 8             | 9             | 4             | 6             | 8             | 3             | 12            | 2             |
| Total for Province..... | 132           | 161           | 278           | 386           | 373           | 409           | 348           | 318           | 248           | 219           | 200           |

From the above figures, it is apparent the black bear is much less abundant on the Island of Cape Breton than on the neighbouring peninsula. A bounty of \$25 is paid on bears in Inverness County; it is therefore not surprising that the local people make every effort to secure an animal when its presence in their neighbourhood becomes known. On the other hand, as all but three mainland counties pay a bounty of only \$10, the incentive is not so great; yet far more are taken on the peninsula. It seems safe to assume, therefore, that the mainland population is greater than that existing on the island.

The more unsettled parts of the mainland have a fairly dense population, according to Rand (1933), Sheldon (1936), and Cameron (1949). This is particularly true in the provincial game sanctuaries.

During the course of field investigations on Cape Breton Island, the writer saw evidence of black bears on only one occasion. On June 2 tracks and scats were seen near a hillside cave on a mountain west of Nevada Valley. Reports of bears in the Brook Village and Mull River areas were received, but no positive evidence could be obtained. A report by woodsmen that bear tracks have been seen in late December would suggest that these mammals go into hibernation rather late in the season. Perhaps this is understandable, as often there is little snow before the first of January and the lowest winter temperature is rarely below zero. On the other hand, Gilpin states that bears go into hibernation late in November or early December. This would seem to constitute additional evidence of a climatic change in the region since 1867. Similar evidence is apparent from a comparison of the meteorological data for the two periods.

*Specimens.* The National Museum of Canada has no specimens from the island.

*Distribution in Region.* See Distribution Map No. 18.

#### **American Pine Marten.** *Martes americana americana* (Turton)

*General.* Marten were formerly widespread throughout the island, but as there have been no recent reports of their occurrence, they are now thought to be rare or extinct. Clarke (1942) reported that Warden John Roach seized two pelts at Cap Rouge, Inverness County, before the



National Park was established and that Roach believed a good nucleus of breeding stock existed in the Park area in 1941. Gould (1935) states that two were taken by trappers at Frizzleton in 1929. Mr. John Simon Fraser saw two tracks in the winter of 1940-41 near the Park boundary.

The lack of reports of this species does not necessarily indicate their absence, as very little trapping is now carried on in the wilder parts of the island where marten would most likely occur. Furthermore, these mammals have been rare for such a long period of time that it is unlikely that the average woodsman would recognize their tracks.

Marten apparently occur in small isolated colonies which can be readily obliterated through persistent trapping. They are more easily trapped than weasel or mink.

*Specimens.* No specimens of this species from Cape Breton Island have found their way into scientific collections.

*Distribution in Region.* See Distribution Map No. 20.

#### **Ermine.** *Mustela erminea richardsonii* Bonaparte

*General.* The ermine appears to be uncommon throughout most of the island as only one was observed by the 1953 field party, and even over a trapping period of nine years on the west coast of the island the writer seldom secured it. According to reports from trappers, it is more abundant in the Bras d'Or Lakes area and in the Margaree Valley than elsewhere. There is some evidence that ermine are cyclic, but the fluctuations appear rather irregular. There is some difference of opinion among collectors whether the cycle, if there is one, is of four or ten years duration. Possibly if they are preying chiefly on mice, they would follow a four-year cycle. In Cape Breton Island, they appeared to be most abundant in the winter of 1935-36. None were taken in the winter of 1939-40, but the scarcity may have been local. Anderson (1942) and Clarke (1942) reported that they were common in the National Park in 1935 and 1941. Gould (Anderson, 1942) found them common in the Cape North and Frizzleton areas in the early autumn of 1935.

Fluctuations in ermine, if such exist, are not evident in the fur returns published by the Nova Scotia Department of Lands and Forests. However, the number of pelts exported from the island being small compared with those from the mainland suggests that the population density is lower in the former area.

*Specimens.* Victoria County: Cape North, 16; Inverness County: Frizzleton, 3; Richmond County: St. Peters, 2.

*Distribution in Region.* See Distribution Map No. 21.

#### **Eastern Mink.** *Mustela vison vison* Schreber

*General.* The mink is fairly common and is widely distributed throughout the island. At least a few pairs occur along all the larger streams, such as the Margaree, Middle, Mabou, Cheticamp, Mira, and Skye rivers as well as in the vicinity of the smaller brooks. A trapper in the Broadcove area, near Inverness, took fourteen along a 5-mile stretch



of a small brook in the winter of 1953-54. The writer has seen mink and their tracks along the Bras d'Or Lakes at Whycocomagh, Bucklaw, and River Denys. Tracks have also been observed on brook edges at Brook Village, Cape North, south Lake Ainslie (Trout Brook), and at Port Hood.

Anderson (1942) found mink fairly common in northern Victoria County in 1924, but Gould (Anderson, 1942) found them scarce in the autumn of 1935.

Although Cape Breton Island constitutes 20 per cent of the total land area of the province, it produces on an average only about 8 per cent of the mink. In addition, the island has 30 per cent of the province's population, and it is natural to suppose that the proportion of trappers is about equal to that of the mainland. Therefore, if the population density of mink were the same on island and mainland, the numbers trapped should be proportional.

*Distribution in Region.* See Distribution Map No. 22.

#### **Eastern Canada Otter.** *Lutra canadensis canadensis* (Schreber)

*General.* The otter occurs in the larger rivers on the island but is nowhere abundant, and the total population must be relatively low. On the other hand, there appears to be little fluctuation in numbers such as occurs in other fur-bearers. Reports of this species have been received from the Margaree River, Middle River, and Mira River areas. Anderson (1942) reports that it is rare in the Cape Breton Highlands Park area, although probably well distributed (Clarke, 1942). Gould (1935) does not mention having observed this animal in the Cape North or Frizzleton areas.

According to figures published by the Nova Scotia Department of Lands and Forests, less than 5 per cent of the pelts exported from the province originate on Cape Breton Island despite the fact that the land area of the island constitutes 20 per cent of the total land area for the province. It would also appear that otter are most abundant in the eastern part of the island, although the higher catch may be due to a larger number of trappers in the area.

*Distribution in Region.* See Distribution Map No. 24.

#### **Cougar.** *Felis concolor* True

*General.* The cougar has been recorded in New Brunswick, Maine, and western Nova Scotia (Wright, 1948, 1953) within recent years, and there is every possibility that it occurs on Cape Breton Island. A recent sight record from the island appears to indicate its presence there. Mr. Albert A. Chisholm of Nevada Valley stated (in litt.) that on October 14, 1954, while night driving near Nyanza, Victoria County, a large cat, which he assumed to be a lynx, leaped in front of his automobile. The cat paused in the glare of his automobile lights for several minutes, and he noticed with surprise the long tail which the cat swung slowly from side to side. He estimated that the animal measured about six feet from the tip of the snout to the base of the tail. It is difficult to imagine this mammal being confused with any other species.



**Canada Lynx.** *Lynx canadensis canadensis* Kerr

*General.* The lynx is now much less common in Nova Scotia than in former years, and it appears to be more abundant on Cape Breton Island than on the mainland. Prior to 1864 it was more or less common throughout the province, according to Gilpin (Rand, 1933), and about 250 skins were exported annually. The 1948-49 winter records show that only thirty-four were exported from the province, and in 1951-52 only five pelts were exported.

The lynx exhibits a cycle that generally follows closely that of the snowshoe hare. In the winter of 1940-41 lynx were very abundant in the Cape Breton Highlands National Park according to wardens' reports, while throughout the eastern part of the province the snowshoe hare reached its peak of abundance in the winter of 1938-39, in southwestern Nova Scotia in 1939-40, and in central Nova Scotia and the Isthmus of Chignecto area in 1940-41 (Cameron, 1949). Lynx have been so scarce since 1940 that a cycle is not evident in the records maintained by the Nova Scotia Department of Lands and Forests.

The peak of the lynx cycle occurred earlier in Eastern Canada west of the St. Lawrence River. In the region north of Lake Huron and Lake Superior, the peak was reached in 1934, while in 1935 the peak occurred in the James Bay region and in 1936 on the north shore of the Gulf of St. Lawrence (Elton and Nicholson, 1942b). Earlier peaks occurred in 1849, about 1888, and sometime between 1912 and 1916. A cycle of 9.6 years has been established for the lynx, according to Elton and Nicholson. It is interesting to note that over a forty-eight-year period ruffed grouse in Nova Scotia had five cycles averaging 9.4 years in duration (Cameron, 1949).

According to data compiled by the Nova Scotia Department of Lands and Forests on the number of lynx pelts exported from the province, approximately 50 per cent are taken on Cape Breton Island.

*Distribution in Region.* See Distribution Map No. 25.

**Nova Scotia Bobcat.** *Lynx rufus gigas* Bangs

*Taxonomy.* Because of its large size and dark coloration, the bobcat of the Maritime Provinces has been regarded until recently as a distinct species, the Nova Scotia wildcat, *Lynx gigas*. Although long suspected of representing a subspecies of *Lynx rufus*, its taxonomic status was not established until Peterson and Downing (1952) made a critical study of eastern bobcats. Among the specimens examined from southeastern Maine, extreme northern New Hampshire and Vermont, and southwestern New Brunswick, some seemed clearly referable to *gigas*, some to *rufus*, and others appeared intermediate. Specimens from east of this area were clearly referable to *gigas* and those west and south to *rufus*.

The race *gigas* differs from *rufus* in having no distinct markings on the back, a more hoary appearance, and a greater admixture of black on the upperparts. The dark markings on the legs, so conspicuous in specimens of *rufus* in the National Collection, are indistinct in the *gigas* specimens.



It seems probable that *Lynx rufus gigas* arose in the coastal area east of the Appalachian Mountain Range where it was effectively isolated from the bobcats of central North America. Had amelioration of the climate not removed the barrier, undoubtedly the coastal population would have eventually evolved as a distinct species. The narrow zone of intergradation between the two races strongly suggests that they have come together only within relatively recent times.

*General.* The bobcat is much less common on the island than in peninsular Nova Scotia while the reverse is true with regard to the lynx. According to provincial fur returns for the period 1932 to 1949, a total of fifteen wildcats were taken on the island, chiefly from Cape Breton County.

Anderson (1942) states that there are no claims of these mammals occurring on the island, but Clarke (1942) reports that Warden Roach stamped six pelts from the National Park area before the Park was established.

No evidence for the occurrence of this species on the island was found by the 1953 field party, and no definite reports were received from woodsmen or trappers. Both the lynx and the bobcat are generally referred to as "wildcats" with the result that the records are unreliable.

#### **Northern White-tailed Deer.** *Odocoileus virginianus borealis* Miller

*General.* The abundance of the white-tailed deer on Cape Breton Island is attested by the fact that no less than 10,293 were killed there during the 1953 hunting season. Since the island has a land area of only 3,975 square miles, this means that, on the average, 2.6 deer were killed per square mile. Game management biologists consider that, in the case of a species that breeds in its second year, the annual kill cannot exceed the total number of yearlings if the population is to remain stable (Leopold, 1933). It has been determined that in most populations the yearlings constitute about 20 per cent of the total population. Assuming, therefore, that the 1953 kill was equal to the yearling population, this would mean that the total deer population on the island cannot be less than 50,000 or about 12.5 deer to the square mile.

A total of 43,330 were killed in the province as a whole in 1953. This represents a kill of slightly over two deer to the square mile. The estimated population for the province, therefore, would be more than 200,000 or about ten deer to the square mile. This would seem to indicate that the density of deer on the island is greater than that on the mainland. Sportsmen believe that the greatest concentration of deer in the eastern part of the province is to be found in southern Victoria County.

The annual deer kill for the province has exceeded 30,000 since 1937, with an ever-increasing number being taken each succeeding year, indicating that the kill is not exceeding the annual increment, and in all probability not equalling it. As a fine is imposed on hunters not submitting a return, the figures on kills are undoubtedly accurate within 10 per cent. There is the possibility that some hunters do not report their total kill, particularly if it exceeds the legal limit of two animals of either sex.



On the other hand, there is a suspicion in certain circles that not all unsuccessful hunters submit a return of "no kill." Perhaps the false reports of kills tend to cancel out those not reported.

The reproductive rate in the province appears to be high, because nine of the seventeen does examined had twins, seven had a single young, and one was barren. Although the sampling is small, these results would suggest that about half of the does bear fawns, and the average number of fawns per doe is 1.5. Two of the seventeen does examined were less than a year old (Annual Report of the Nova Scotia Department of Lands and Forests for 1951, published in 1952).

A deer season was first declared on the island for Richmond County in 1922. However, no animals were reported taken until 1927 when two bucks and one doe were reported killed during the forty-day open season. An open season for the entire island was declared in 1928, when thirty-one were reported killed during a thirty-day period.

Deer were observed in all parts of the island during the 1953 field season. On the basis of the number of animals and tracks observed, it would appear that the highest densities occur in an area bounded by the Margaree River on the north, Baddeck and Iona on the east, West Bay on the south, and Glencoe on the west. This is also the area in which agricultural losses are the greatest.

Because of its abundance on the island, the deer is an agricultural pest of no mean importance. Truck gardening in certain inland areas is often unsuccessful because of repeated nightly visits by deer. A wide variety of scaring devices have been tried, but few have proved effective. In 1945 several farmers in the Brook Village area enclosed their gardens with 8-foot rail fences, which, however, proved ineffective. Burlap scarecrows, equipped with umbrellas and posted at intervals in the gardens, were likewise unsuccessful. Only lighted lanterns hanging from poles set at 20-foot intervals throughout the fields proved effective.

According to accounts, the white-tailed deer is not strictly a native of the province but was introduced in 1894 (Department of Lands and Forests, Nova Scotia, Annual Report for 1945). However, it is rather unlikely that the present population consists solely of descendants of these animals. After the deer had extended their range into southeastern New Brunswick about 1870, they undoubtedly crossed the Isthmus of Chignecto into Nova Scotia.

It is clear that there were no deer in the province in 1867 as Duvar (1867) states "...the ordinary American or Virginia deer (*Cervus Virginianus*) has its range from the Gulf of Mexico to the borders of New Brunswick... There can... be no possible hinderence to the introduction of this really valuable game in our coverts..." It is evident that introduction of this species was being considered at that time. Gilpin (1870) states in an address delivered in 1868 that "... I think the Virginia deer (*Odocoileus Virginianus*) will be found in the Cobequid Hills, as I personally know they have been taken near Dorchester, N.B., near the boundary line." It seems likely that the deer extended its range into the province about this time, although it could not have spread far, as the introduction took place some twenty-four years later.



The deer season was first opened on the mainland in 1916 when 154 bucks were killed in the ten-day open season.

In 1926, ten years later, 281 bucks were killed, and in 1936, 1,950 were taken in the province. By 1946 the kill had jumped to 26,750 (13,769 bucks and 12,981 does).

*Distribution in Region. See Distribution Map No. 26.*

**Eastern Moose.** *Alces alces americana* (Clinton)

*General.* According to Clarke (1942), the moose was exterminated on Cape Breton Island before 1924, but a sizable population is said to have existed about 1885 when, according to a local resident, 37 animals were shot during one hunting trip. Clarke also mentions another local hunter who had killed 80 moose in one winter, some time in the late nineteenth century. The disappearance of moose from the island has been attributed to any number of factors, but it seems evident that the excessive kill combined with the destruction of the wilderness habitat played an important role.

The moose was reintroduced into the National Park area in 1947 and 1948. In 1947, eight animals consisting of five adult females, one female calf, and two male calves were released, and in 1948 the shipment consisted of five adult males and five adult females. Both introductions were made in late summer. Following the releases, moose were seen at infrequent intervals, and it was feared that the project was not a success. However, in January 1952, a Park warden observed five near Ingonish, and in 1954 Dr. A. S. MacLaren of the Canadian Department of Mines and Technical Surveys saw two west of Ingonish, just east of elevation 1747. He also saw one at Cheticamp Lake and one at an unnamed lake just east of Cheticamp Lake. Dr. E. R. W. Neale, also of the Department of Mines and Technical Surveys, saw four in the northeast sector of the Park south of the Cabot Trail. These and other observations have raised hopes that the moose are thriving and that they will increase in the Park area and spread out over the island.

*Distribution in Region. See Distribution Map No. 27.*

**Eastern Woodland Caribou.** *Rangifer caribou caribou* (Gmelin)

*General.* When the first settlers arrived on Cape Breton Island, caribou were abundant and were widely distributed. During the period 1880-82 a geological field party working in the northern part of the island saw 150 animals in one band on a barren above Margaree Forks. By 1912 caribou were scarce, and by 1924 they were either very scarce or extinct. Dr. R. M. Anderson of the National Museum of Canada spent more than three weeks in 1924 on the barrens, but all signs he saw were estimated to be more than a year old. Gould (Anderson, 1942) states that caribou disappeared from the National Parks area about 1911, although in 1935 some of the local people believed that a few still existed in the interior of the island. Clarke (1942) was of the opinion that caribou did not survive beyond 1923. Reports of caribou from the mainland suggest that they disappeared from there about 1905.



In 1945 the writer spent several days on the interior barrens in the Ingonish area, but no signs of caribou were seen. In 1953 the writer again visited the northern barrens. In 1954 Dr. A. S. MacLaren of the Canadian Department of Mines and Technical Surveys studied the geology of the Park area. Again there was no sign that caribou had existed there within recent years. Since the barrens are extensive and largely inaccessible, it is possible for a large mammal to exist for many years and escape detection. But the lack of any evidence for more than four decades leaves little doubt that caribou are now extinct on the island.

The disappearance of the caribou is attributed chiefly to excessive hunting rather than to a lack of suitable food, as Clarke (1942) estimated that the highlands could support a population of about 4,000. In 1939 the Province of Nova Scotia negotiated with the Province of Newfoundland to have caribou from the latter province introduced into eastern Nova Scotia, and on April 10 nine females, five of which were with calf, arrived in Halifax. The pregnant cows were liberated in the Liscomb Game Sanctuary, and the others were held in Halifax pending the arrival of three males (Tufts, 1939). The four females and two bulls were eventually liberated, but within a few years the herd had completely disappeared.

*Specimens.* Victoria County: one mounted head with antlers and two incomplete sets of antlers without further data.

*Distribution in Region.* See Distribution Map No. 28.



## THE MAMMALS OF PRINCE EDWARD ISLAND

Prince Edward Island lies in the southern half of the Gulf of St. Lawrence and is separated from New Brunswick, the nearest land mass, by Northumberland Strait, which is 9 miles wide at its narrowest point. The island is 110 miles in length and varies from 2 to 32 miles in width. The land is low-lying and rolling with no elevation over 500 feet.

The soil is a rich sandy loam, which is agriculturally highly productive, and potato raising is an important industry. Originally, the island was heavily forested, but most of the trees have been removed to make way for farms. There is no longer any virgin forest, and more than 85 per cent of the land area is cleared. Most of the existing forest consists of small, scattered woodlots. The most extensive wooded areas are to be found at the east end of the island in the area between St. Peters and Cardigan, and in the centre of the island between Charlottetown and Summerside. Much of the low-lying land at the west of the island consists of cedar and tamarack swamps. It is interesting that the white cedar (*Thuja occidentalis*) occurs on Prince Edward Island but is very rare on peninsular Nova Scotia and totally absent from Cape Breton Island.

The rock formations are believed to be of Permian Age, but the paucity of indicator fossils in the soft sandstones makes geological dating extremely difficult. Along the coasts, sea erosion is extensive, and the disintegration of the soft sandstones has resulted in the formation of broad sandy beaches for which the island is justly famous.

The whole of the island is believed to have been totally glaciated (Goldthwait, 1924), and evidence indicates that the Wisconsin ice-sheet that covered the east end of the island had its centre of origin in the highlands of Cape Breton Island, while the west end was covered by a glacier which originated in the mountains of northern New Brunswick (Prest, pers. comm.).

Whether Prince Edward Island has had a post-glacial land connection is questionable (See Discussion, p. 107, for details). Although geologists are divided in their opinion on this subject, the zoological evidence is highly persuasive. The presence of raised beaches in many sections of the southern Gulf of St. Lawrence has been interpreted as evidence for a general land emergence in the region, in which case no land connections could have existed. On the other hand, the presence of drowned forests in the Isthmus of Chignecto area suggests the reverse—that the land has been subsiding or the water-level has been rising. The zoogeographical evidence, however, seems to be almost wholly in support of the theory of post-glacial subsidence with a land bridge connecting the island and the mainland within relatively recent times. All but four (possibly six) of the mainland species of mammals and most of the amphibians and fresh-water fishes occur on the island. Islands that have had no land connections generally are depauperate in small mammals and amphibians, and the fishes inhabiting the streams and lakes are generally anadromous.



The climate of the island is equable with mild winters and cool summers. Because of the drift-ice which often persists in the waters surrounding the island until late April or early May, the spring is late. The autumn, however, is generally prolonged with little or no snow before the end of December. The mean annual temperature for the island (based on 64 years of observation) is 41.7 degrees F. The maximum recorded temperature was 98 degrees F., and the minimum recorded temperature —27 degrees F. There are 156 frost-free days during the year (Climatic Summaries for Selected Meteorological Stations, Meteorological Division, Department of Transport, Canada, 1954).

Prince Edward Island lies within the Acadian Forest Region, and the principal tree species are as follows: white spruce (*Picea glauca*), black spruce (*Picea mariana*), red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), trembling aspen (*Populus tremuloides*), yellow birch (*Betula lutea*), white birch (*Betula papyrifera*), red maple (*Acer rubrum*), and speckled alder (*Alnus rugosa*). Larch (*Larix laricina*) and white cedar (*Thuja occidentalis*) occur in the swamps and bogs.

#### MAMMALIAN FAUNA

A total of twenty-eight mammalian species are believed to have been present on the island in 1719 when the first colonists arrived. Since that time a number of species have been exterminated, and others have been introduced by man. Four mammal species native to the neighbouring mainland but definitely absent on the island are the striped skunk, raccoon, woodchuck, and porcupine. It seems probable that they arrived in the Maritime Provinces region too late to take advantage of the land bridge previously mentioned (See Discussion, p. 107 for full details).

Because the forested regions on the island are now greatly restricted and the human population is high, most of the larger mammals and the fur-bearers are either very scarce or have been exterminated. The otter, beaver, fisher, and black bear now occur in only a few isolated localities, while the moose and lynx are extinct and have been so for many years. The wolf is believed not to have been resident on the island, although Bain (1890) states that packs occasionally crossed over on the ice from the mainland. Bain further states that the wolverine and caribou did not occur on the mainland even in pre-settlement days.

The flying squirrel, a mammal of mature mixed or coniferous woods, is apparently uncommon. Red squirrels, however, are widely distributed and appear not to have suffered from the widespread deforestation wrought by the white man. The mink is still found in the watered areas and despite continued trapping appears to be holding its own. The relatively high population on the island is probably due to the abundance of trout in the streams fed by the run-off from well-fertilized farm lands.

Although forest species have fared badly on the island, grassland species have benefited by the clearing of the forests. Meadow mice have attained extremely high populations in peak years, and the introduced striped skunk and raccoon, which are parkland species, are now abundant.



Collecting carried on in the summer of 1954 indicates that the deer mouse, a woodland species, is uncommon, in sharp contrast to the situation which prevails on the mainland. It is also interesting that this species is apparently uncommon on Cape Breton Island and Anticosti. The scarcity on Prince Edward Island, therefore, presumably cannot be attributed to the lack of wooded areas. Some undetermined factors appear to be responsible. Red-backed mice and cinereous shrews are not uncommon, but short-tailed shrews appear to be scarce and very local. The scarcity of chipmunks cannot be satisfactorily explained as there appears to be plenty of suitable habitat.

The white-tailed deer has not colonized the island, as it has Cape Breton Island and the neighbouring mainland. Its northward spread into the Maritime Provinces region has been recent: it was first recorded in the Isthmus of Chignecto area in 1868 (Gilpin, 1870). Attempts to introduce this species to the island have been rather unsuccessful, and it is doubtful that a resident population can be established.

#### PREVIOUS WORK

Heretofore no attempt has been made to study the mammalian fauna of the island. The specimens collected by the 1954 field party constitute the only representative series of the island's mammals. Unfortunately this is necessarily incomplete because of the rarity of many species. Bain (1890) included a section on mammals in his "Natural History of Prince Edward Island." It is helpful in that it does provide some valuable information on the mammals still extant on the island at the turn of the century. It cannot, however, be regarded as a scientific treatise. Over the years, Blythe Hurst has published notes on the island's natural history, chiefly with regard to birds and plants.

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#### ACCOUNTS OF SPECIES

##### **Maritime Cinereous Shrew.** *Sorex cinereus acadicus* Gilpin

*General.* This species was among the most abundant of the small mammals in the areas in which collections were made. It also occurred in a wide variety of habitats ranging from the damp borders of streams to dry upland woods. However, the most productive area was one in which there were scattered mature spruce, maple, and birch with an understory of bracken fern (*Pteris*), Clintonia (*Clintonia*), wild sarsaparilla



(*Areliia hispida*), and young birch, pin cherry, maple, and spruce. There was an abundance of well-rotted tree trunks and a deep layer of leaf litter. The ground sloped gently toward a small brook which was well shaded by dense mature spruce and maple, and as a result the habitat was dark and moist. These shrews, like many small mammals, tend to follow along prostrate logs when travelling in the open, and trapping results were best in such situations. The entrances to burrows, presumably of this species, were quite apparent in the area. Because of the dampness of the woodland, the abundance of slugs proved a nuisance as they fed on the specimens in the traps.

*Specimens.* Kings County: Souris, 6; Fortune, 12; Rollo Bay, 26; Queen's County: Hunter River, 2.

*Distribution in Region.* See Distribution Map No. 1.

**Northern Smoky Shrew.** *Sorex fumeus umbrosus* Jackson

*General.* This is the first record of this species for the island. The single specimen was taken in an open mature mixed woodland with an abundance of ground cover and well rotted leaves.

*Specimens.* Kings County: Fortune, 1.

*Distribution in Region.* See Distribution Map No. 2.

**Maritime Pigmy Shrew.** *Microsorex hoyi thompsoni* (Baird)

*General.* The Chicago Museum of Natural History has two specimens from Georgetown, Kings County, and one specimen from Alberton, Prince County (Miller and Allen, 1928).

*Distribution in Region.* See Distribution Map No. 4.

**Northeastern Short-tailed Shrew.** *Blarina brevicauda pallida* R. W. Smith

*Taxonomy.* This race is paler than the other subspecies of the *Blarina brevicauda* group. The two Prince Edward Island specimens, like those from Cape Breton, lack the brownish cast on the belly. Otherwise, they are reasonably typical *pallida*. This race, however, is not particularly well defined, especially since the diagnostic characters are based chiefly on colour.

*General.* This species is evidently uncommon on the island as no specimens were secured by the 1954 field party. However, short-tailed shrews are generally local in distribution over most of their range, and it is very probable that areas chosen for trapping did not embrace a population of the species. Nevertheless, many habitats that were well trapped appeared favourable for *Blarina*, and it was surprising that none were collected.

*Specimens.* Queens County: Southport, 1; Mount Herbert, 1.

[**Mole**—Bain (1890) mentions this species as occurring on the island. The star-nosed mole (*Condylura cristata*) might be expected to occur, but no specimens have been taken to date.

*Distribution in Region.* See Distribution Map No. 6.]



**Little Brown Bat.** *Myotis lucifugus lucifugus* (LeConte)

*General.* The local residents report that bats are quite frequently seen during the summer months. However, the summer of 1954 was very cold and wet, and very few were seen and none collected. Two bats were seen near a small roadside pond south of Selkirk, Kings County, on July 4th and 5th, but they remained in the area for only a few minutes and could not be collected.

Since there are no natural caves and relatively few large hollow trees available, bats on the island presumably hibernate in buildings. It is also possible that a number migrate south for the winter.

*Records.* Queens County: Mount Herbert, 3 (Specimens in the United States National Museum).

**Red Bat.** *Lasiurus borealis* (Müller)

A large bat, believed to be this species, was observed flying across a highway near Fortune Bridge on June 7 about an hour before sundown. The relatively large size and the slow erratic flight are characteristic of the red bat. This species has not been previously collected on the island, and only five specimens are recorded from New Brunswick. There are no records of its occurrence in Nova Scotia. It is highly probable that several species of bats occur in the Maritime Provinces which have not as yet been recorded.

**Nova Scotia Snowshoe Hare.** *Lepus americanus struthopus* Bangs

*General.* Snowshoe hares were very scarce in the summer of 1954; only two were seen in the seven-week period spent by the field party on the island. Unfortunately there are no data available on the cyclic fluctuations of this species in this area. Local residents reported, however, that hares were quite plentiful in the winter of 1951-52. In nearby Nova Scotia, a peak occurred in 1940-41 and again about 1951-52. It is quite possible therefore that the hares on the island follow closely the fluctuations of the animals in the Isthmus of Chignecto area.

Hares are most abundant in peak years at the east end of the island in the area between Souris and Georgetown and at the west end in the area between Wellington Station and Alberton, where the extensive cedar swamps provide both food and shelter in the winter months.

*Specimens.* Prince County: Alberton, 1.

*Distribution in Region.* See Distribution Map No. 8.

**Northeastern Chipmunk.** *Tamias striatus lysteri* (Richardson)

*Taxonomy.* Compared with Ontario material, specimens from the Maritime Provinces are brighter and more richly coloured, but the two populations do not differ sufficiently to warrant the recognition of a distinct race in the Maritime Provinces.

*General.* The chipmunk is rather uncommon on the island despite the fact that there is a great deal of apparently suitable habitat. Only three were seen during the two-month period spent on the island—two near Souris, Kings County, and one at Hunter River, Queens County.

*Specimens.* Queens County: Mount Herbert, 1.

*Distribution in Region.* See Distribution Map No. 10.



**Red Squirrel.** *Tamiasciurus hudsonicus gymnicus* (Bangs)

*General.* This species is common and widely distributed throughout the island. Despite the large tracts under cultivation, there are still numerous farm woodlots, a half acre or more in extent, where it finds conditions favourable. Proximity to grain fields seems to be to its advantage as the waste oats in the stubble provide an additional source of food. Hollow trees and abandoned woodpecker holes presumably are utilized as nesting sites since no tree nests were observed.

A female collected on June 4 was lactating, presumably indicating that the young are born in late May.

*Specimens.* Kings County: Fortune, 1; Queens County: Hunter River, 2; Mermaid, 2.

*Distribution in Region.* See Distribution Map No. 1.

**Nova Scotia Flying Squirrel.** *Glaucomys sabrinus gouldi* Anderson

*General.* Heretofore this species was unrecorded for the island, although there is a mounted specimen in the Museum collection at Prince of Wales College. This specimen, however, is old and faded and of dubious value for taxonomic purposes. Two specimens were collected by the writer near Rollo Bay, not far from Fortune, in a mature mixed woodland. The habitat was quite characteristic of the species—tall, mature woods with a sparse understory and an abundance of rotted, prostrate logs. Shin-leaf (*Pyrola*), twin-flower (*Linnaea*), and clintonia (*Clintonia*) were characteristic species in the area. Both specimens were taken in regular museum snap-back traps, and peanut butter was used as a bait. The traps had been set near brush piles especially for red-backs and deer mice.

Apparently this species is uncommon on the island, as woodsmen had encountered very few and local trappers had not found them common.

*Specimens.* Kings County: Rollo Bay, 2.

*Distribution in Region.* See Distribution Map No. 1.

**Beaver.** *Castor canadensis* Kuhl

*General.* The presence of beaver tooth-marks on sticks found in peat bogs shows that beaver originally inhabited the island. However, probably with the settling of the country and the destruction of woodlands for agricultural purposes, the population declined, and the beaver were eventually exterminated, probably before the turn of the century. The demand for beaver skins and the wholesale trapping of these animals, in a region with no inaccessible areas, quickly reduced the population.

In 1909 ten pairs were introduced from Algonquin Park, Ontario, and there have been several introductions from New Brunswick. There are now several colonies scattered over the few wilderness parts of the island, chiefly at the east and west ends. They have been observed to swim out to the tidal flats and to drown in the salt water. Since the number of suitable areas on the island is restricted, it is unlikely that the population will increase sufficiently to allow trapping. A large population on the island would probably prove undesirable, because beaver often flood valuable farm lands and roads and thus gain disfavour.



Since the beavers now present on the island are not native and are descendants of animals belonging to two distinct subspecies, no attempt was made to collect animals for taxonomic purposes.

*Distribution in Region.* See Distribution Map No. 11.

**Maritime Deer Mouse.** *Peromyscus maniculatus abietorum* (Bangs)

*Taxonomy.* Specimens of *abietorum* from Prince Edward Island, Cape Breton Island, and southwestern Nova Scotia are the greyest of eastern forms with a cline, tending toward brownness, extending west to the Gaspé Peninsula (Cameron, 1953). The brownishness of specimens from northern New Brunswick and the Gaspé Peninsula is probably due to intergradation with *gracilis*, the race occurring in Ontario and southern Quebec.

*General.* Deer mice were apparently very scarce on the island in the summer of 1954. A single specimen was taken on June 1 in a dry upland wood bordering a hayfield. It is interesting to note that this species was also scarce on Cape Breton Island in the autumn of 1935, the summer of 1953, and presumably in the autumn of 1924. This might suggest that deer mice attain considerably lower densities on the islands than on the mainland. By contrast, a total of forty-two specimens were trapped by the writer at the Dartmouth River on the Gaspé Peninsula during a four-week period in 1951 (Cameron, 1953).

*Specimens.* Kings County: Fortune, 1; Queens County: Charlottetown, 2; Hazelton, 1.

*Distribution in Region.* See Distribution Map No. 12.

**Nova Scotia Red-backed Mouse.** *Clethrionomys gapperi pallescens* Hall and Cockrum

*Taxonomy.* This race is characterized by its pale colour, heavy rostrum, and greater cranial and interorbital breadth. Compared with *ochraceus*, which occurs in New Brunswick, southeastern Quebec, and the northern New England States, *pallescens* is considerably paler dorsally. In many specimens the dorsal reddish-brown band is so ill-defined as to be scarcely discernible. In a mixed series of the two races, specimens of *pallescens* are readily separable by their paler and brighter dorsal coloration (Smith, 1940; Hall and Cockrum, 1952; Cameron, 1953).

*General.* Red-backed mice were among the most abundant of the small mammals in the areas trapped by the 1954 field party. A wooded area at Fortune, through which flowed a small brook, was particularly productive. Second-growth red and sugar maples occupied most of the area, and scattered mature white spruce and red maple formed a broken canopy. Most of the understory consisted of bracken fern (*Pteris*) which so effectively shaded the forest floor that no low vegetation could develop. Numerous half-rotted tree-trunks and a deep layer of decaying leaves and other vegetation provided ideal conditions for red-backs. Because of the proximity of the brook, the humidity was maintained at a high level. As was pointed out in the Cape Breton Island section of this account, the water requirements of the red-back are high compared with other mammals of similar size. Generally, red-backs attain the highest densities in



sub-climax communities, which result from lumbering or forest fires. Since most of the farm woodlots are sub-climax, ideal conditions exist for these mammals.

*Peromyscus* and *Sorex cinereus* were taken in similar habitat, although most of the deer mice were trapped on higher and drier ground.

*Specimens.* Kings County: Fortune, 10; Rollo Bay, 9; Souris, 2; Queens County: Hunter River, 4; Southport, 2.

*Distribution in Region.* See Distribution Map No. 1.

**Acadian Meadow Mouse.** *Microtus pennsylvanicus acadicus* Bangs

*Taxonomy.* This race averages slightly larger and paler (more russet) than the nominate race, but smaller than the Newfoundland form *terraenovae*, which is pale but lacks the russet cast that is so characteristic of *acadicus*. Specimens from Prince Edward Island show this character more distinctly than those from Nova Scotia, although material from the southwestern part of that province are well marked in these respects.

*General.* Meadow mice were fairly common, apparently, in a few restricted areas near Souris and Fortune during the summer of 1954. In many of the meadows and overgrown pastures, numerous runways were apparent, presumably constructed the previous year. On the basis of the number of specimens collected and the relatively few runways in use, it is concluded that there was a rather heavy winter kill. Red foxes and skunks were abundant on the island, and it is reasonable to suppose that they were at least partly responsible for the decimation of the *Microtus* population. Possibly another contributing factor was the lack of snow for the greater part of the early winter and the heavy rains in early spring. Lack of snow not only renders these rodents susceptible to predation but results in high mortality because of exposure. During the years of heavy precipitation fewer litters are apparently produced and the mortality is greater.

Most of the specimens collected were taken in low-lying areas near brooks and swamps, characterized by a heavy growth of dead grasses from the previous year. Many of them contained a good deal of shrubbery and young trees, such as *Rosa* sp., *Spirea* sp., *Prunus pennsylvanica*, *Abies balsamifera*, *Picea glauca*, and *Cornus stolonifera*.

Various baits were used, such as peanut butter, amberoid glue, oatmeal, raisins, and bacon grease, but apparently there was little correlation between the type of bait used and the catch. From results obtained here and elsewhere it would appear that meadow mice are not especially attracted by artificial baits and that they are captured only because the traps have been set in runways which are in use. It also seems apparent that a smaller percentage of a population of *Microtus* is taken in traps than other species, because few may be taken in any area where many have been observed and where there is ample evidence of a fairly large population. Snap-back traps were used, but the regular museum traps are frequently not powerful enough to retain the larger animals.

*Specimens.* Kings County: Souris, 5; Queens County: Mount Herbert, 2.

*Distribution in Region.* See Distribution Map No. 14.



**Eastern Muskrat.** *Ondatra zibethicus zibethicus* (Linnaeus)

*General.* Muskrats are widely distributed throughout the ponds, streams, and marshes on the island and in many areas reach surprisingly dense populations. The abundance of these rodents is due in part, at least, to the large quantities of food plants. Since fertilizers, both organic and inorganic, are extensively used in the potato growing, the runoff into the rivers and ponds is well supplied with nutrients, and the aquatic life is correspondingly rich. The cattail (*Typha*) is an abundant species in most of the freshwater areas and makes up the greater part of the muskrat's food, as was evident from cuttings. Errington (1948), in his studies on the ecology of the muskrat, has found that this plant is by far its most important food. In its absence the animals are few in numbers, and their pelts are of inferior quality.

Muskrats were especially abundant in the Black Ponds Bird Sanctuary east of Souris. Along the shallow shores of this large pond, heavily vegetated with cattail, numerous houses were observed. Muskrats were also found to be common in the marshes bordering the rivers near Fortune Bridge, St. Charles, Mount Hope, Wreck Cove, Montague, Morell, Mount Stewart, Cavendish, Hunter River, Kensington, the outskirts of Summerside, and at Hamilton.

Near Fortune, muskrats were observed in tidal marshes. Furriers report that the pelage of muskrats living in such situations is inferior to that of muskrats which live exclusively in fresh water. Hence, a percentage of muskrat pelts from Prince Edward Island brings a lower price than those collected on the mainland.

*Specimens.* Queens County: Mount Stewart, 2.

*Distribution in Region.* See Distribution Map No. 15.

INTRODUCED:

**Norway Rat.** *Rattus norvegicus* (Berkenhout)

*General.* This species is widely distributed throughout the province. Farmers reported that especially large concentrations are noted in areas where unsaleable potatoes are discarded. In one such refuse heap near Fortune, hundreds of rats could be seen in early evening scurrying among the piles of potatoes.

INTRODUCED:

**House Mouse.** *Mus musculus domesticus* Ratty

*General.* This species is a common pest in dwellings as elsewhere in Canada. One specimen was collected at Fortune, Kings County, on June 25.

**Acadian Meadow Jumping Mouse.** *Zapus hudsonius acadicus* (Dawson)

*General.* In Eastern Canada jumping mice are rather sparsely distributed throughout their range, and relatively few are taken by collectors even under the most favourable conditions. It was therefore satisfying to collect six specimens of the present species in a five-week period. Most of these were trapped along the flood bank of a small brook, which flowed through a farming area. The vegetation flanking the brook consisted chiefly of mature speckled alder (*Alnus rugosa*) and in the drier parts, wild rose



(*Rosa*) with a dense growth of wild grasses and herbaceous plants as an undestory. Jumping mice apparently follow the banks of streams in their travels, because traps set in such areas are the most productive. It is also believed that they feed on the rootlets exposed by stream erosion. Meadow mice and cinereous shrews were also taken in the same habitat.

*Specimens.* Kings County: Fortune, 6; Queens County: Mount Herbert, 2.

*Distribution in Region.* See Distribution Map No. 1.

#### **Woodland Jumping Mouse.** *Napaeozapus insignis insignis* (Miller)

*General.* The two specimens of this species, collected by the 1954 field party, constitute the first record for *Napaeozapus* for the province. As this mammal is not abundant in any part of Eastern Canada, comparatively speaking it cannot be said to be a rare species on the Island.

The first specimen, collected on June 4 at Rollo Bay, Kings County, was taken in a trap set on a decayed log partly buried in the soil. A small brook flowed through the area in which the trap was set, and the surrounding vegetation consisted of speckled alder, white spruce, wild rose, and meadow rue (*Thalictrum polygamum*) with a rank growth of various grasses covering the ground. Numerous unused trails of meadow mice meandered through the grass and may have been used by the jumping mouse.

The second specimen, trapped on June 9, was taken in a trap located about 30 feet from the one in which the first specimen was trapped.

*Specimens.* Kings County: Rollo Bay, 2.

*Distribution in Region.* See Distribution Map No. 1.

#### **Northeastern Red Fox.** *Vulpes fulva rubricosa* Bangs

*Taxonomy.* The original red fox population was undoubtedly referable to *rubricosa*, but the present foxes are of mixed derivation—a result of the importation of silver-phased animals at a time when fur prices were high. With the decline in prices in the late thirties and early forties, many foxes were released, and no attempt was made to recapture those that had escaped.

*General.* The red fox is a common species on the island and has been since about 1945. While fur prices were high in the late thirties, the population was maintained at a low level as a result of intensive trapping. With the decline in the value of the pelt, trapping was largely discontinued, and the population rose at an alarming rate. Only since 1951 has there been any evidence of a levelling off.

The tracks of this species were frequently seen along the sand dunes, and the animals themselves were seen at the following points: Shipwreck Point, Dundas, Mount Hope, and Murray River, Kings County; and at Hunter River, Hartsville, and Rustico, Queens County. A den was located in the side of a small ravine near Rollo Bay on June 14. The female, a "patch fox," was seen on several occasions.



Fur farming was an important industry until about 1938 when a decline in the fur prices made it unprofitable. At the present time several ranchers specialize in the raising of the more valuable mutations such as the "platinum" foxes.

The local residents are of the opinion that the red fox is responsible for the scarcity of hares and such upland game birds as pheasants, Hungarian partridges, and ruffed grouse.

*Distribution in Region. See Distribution Map No. 17.*

**Black Bear.** *Ursus americanus americanus* Pallas

*General.* The black bear is now believed to be extinct on the island, although from time to time reports are received of animals having been seen. As recently as 1953 woodsmen reported having seen a bear in the Dundas area, Kings County, but the report does not appear to be well authenticated. Since only 15 per cent of the land area is forested and most of this is broken up into small farm woodlots, it is obvious that there is little suitable habitat left for large mammals. It was not uncommon at the east and west ends of the island in 1890 (Bain, 1890).

*Distribution in Region. See Distribution Map No. 18.*

**INTRODUCED:**

**Raccoon.** *Procyon lotor* (Linnaeus)

*General.* According to Mr. J. S. Jenkins, Chief Game Warden, the first recorded instance of a raccoon having been released on the island was in 1912. Several years later, when the price of raccoon pelts declined, ranchers released their animals. The present island population is therefore derived from these releases. They are now quite abundant, especially at the east and west ends of the island. The first bounty of \$3 per snout was introduced in 1953, when 323 were offered for bounty. The following are figures on the number offered for bounty since that time: 1954, 460; 1955, 1,663; 1956 (incomplete), 1,462.

The varied terrain on the island, consisting of second-growth mixed woods, fields, meadows, and marshes, is well suited to this species, which has attained a high density, especially in well-watered areas. The tracks were frequently seen by the 1954 field party, especially along the damp, muddy borders of brooks. The animals themselves were also occasionally seen. No specimens, however, were collected.

*Distribution in Region. See Distribution Map No. 19.*

**Pine Marten.** *Martes americana* (Turton)

*General.* Bain (1890) states that the marten is "... a woodland animal nesting in hollow trees and feeding on birds and small animals. It is the size of a mink, but fawn-colored." He does not say that it occurred on Prince Edward Island, but as it is included among what is presumably a list of the island's mammals, it would appear that it was present at the time of writing. That it should occur on the island is not surprising since it occurs on all of the other larger islands in the Gulf except the Magdalens.

*Distribution in Region. See Distribution Map No. 20.*



**Eastern Fisher.** *Martes pennanti pennanti* (Erxleben)

*General.* From time to time reports of this species are received by the Department of Industry and Natural Resources. Two such reports were received by Mr. Spurgeon Jenkins in the winter of 1948-49. From the descriptions received, the animal could have been no other.

It is interesting that a wilderness mammal such as the fisher could survive on an island where 85 per cent of the land area is under cultivation and where wooded areas are isolated by broad stretches of farmlands. However, since very little trapping is carried on by the people on the island, it is conceivable that a small population might have survived. As there is generally an abundance of small mammals, such as snowshoe hares, red-backed mice, and meadow mice, food is probably not an important delimiting factor.

**Richardson's Ermine.** *Mustela erminea richardsonii* (Bonaparte)

*General.* A specimen of this species collected on July 11 at Rollo Bay constitutes the first definite record of this species for the island. Each year, of course, the local residents forward the pelts to furriers. The specimen, a female, was trapped under a barn near a poultry house.

*Specimens.* Kings County: Rollo Bay, 1.

*Distribution in Region.* See Distribution Map No. 21.

**Eastern Mink.** *Mustela vison vison* Schreber

*General.* The mink is not uncommon on the island, and tracks were observed frequently along streams and brooks both on the coast and in the interior. The relatively high population in a region where no true wilderness exists and where the streams tend to be small and shallow, is largely due to the abundance of trout in the island's ponds and brooks. The run-off from the heavily fertilized fields has enriched the waterways to such an extent that a high population of fresh-water fish can be maintained. Amphibians, especially leopard frogs (*Rana pipiens*), also appeared to be unusually common in damp meadows and along stream borders.

According to Spurgeon Jenkins, Chief Game Warden for the Island, mink often enter the salt water at the estuaries of streams; this may account for the inferiority of island mink for fur purposes. Nevertheless, they are unusually large compared with mainland mink.

No figures on the annual take are available to the writer.

*Distribution in Region.* See Distribution Map No. 22.

**INTRODUCED:****Striped Skunk.** *Mephitis mephitis* (Schreber)

*General.* This species was brought to the island by fur-ranchers and subsequently released when the fur prices dropped to a point where it was no longer profitable to raise them. The open farmlands with scattered woodlots provided ideal habitat, and the population increased rapidly. In an effort to check the increase, the provincial government was obliged to



impose a bounty of \$1 for each animal destroyed. The following is a table showing the number of animals submitted for bounty from 1932 to 1944 and from 1951 to 1956:

| Year | No.   | Year              | No.   | Year | No.          |
|------|-------|-------------------|-------|------|--------------|
| 1932 | 5,561 | 1939              | 3,298 | 1951 | 4,791        |
| 1933 | 5,643 | <sup>1</sup> 1940 | 586   | 1952 | 4,395        |
| 1935 | 3,114 | <sup>1</sup> 1941 | 2,168 | 1953 | 2,924        |
| 1936 | 3,474 | 1942              | 9,763 | 1954 | 4,047        |
| 1937 | 4,064 | 1943              | 5,987 | 1955 | 5,643        |
| 1938 | 3,117 | 1944              | 4,012 | 1956 | 4,388        |
|      |       |                   |       |      | (incomplete) |

<sup>1</sup> (Bounty was not paid for parts of these years)

It is interesting to note the effect of non-payment during parts of the years 1940 and 1941—in 1942 no less than 9,763 were offered for bounty.

The only natural predator of the skunk on the island seems to be the Great Horned Owl, and unfortunately a bounty of \$1 was also imposed on it, presumably because it destroys game birds. During the period 1932 to 1944, a total of 1,124 owls were submitted for bounty payment. Not all of these, however, were Great Horned Owls—even tiny Saw-whets were included in the number (Cameron, 1945c).

Skunks are most abundant at the east and west ends of the island. Residents are of the opinion that there has been a slight decrease within recent years. According to Mr. J. S. Jenkins, the population declined rapidly in 1953, possibly the result of an epidemic. However, since that time there has been a rapid increase in the population.

*Distribution in Region.* See Distribution Map No. 23.

#### **Eastern Canada Otter.** *Lutra canadensis canadensis* (Schreber)

*General.* According to Chief Game Warden Spurgeon Jenkins, the otter is still extant on the island, but very rare. Suitable habitat must now be very restricted indeed. There has not been an open season for many years. It is mentioned as a native species by Bain (1890).

*Distribution in Region.* See Distribution Map No. 24.

#### **Lynx.** *Lynx canadensis* Kerr

*General.* Bain (1890) states that this species was originally not uncommon on the island but was extinct at the time of writing.

*Distribution in Region.* See Distribution Map No. 25.

#### **INTRODUCED:**

#### **Northern White-tailed Deer.** *Odocoileus virginianus borealis* (Miller)

*General.* The first white-tailed deer were introduced on the island in 1949 when a pair was presented to the Premier of the Province. The buck was shot the same autumn, but the doe survived and wintered over on St. Peter's Island, which is connected to the mainland by a sandbar at



low tide. She was reported in the autumn of 1950 at a point about 20 miles from Charlottetown in Prince County. In the summer of 1951 a total of twelve orphan fawns (ten does and two bucks) were obtained from the Nova Scotia Wildlife Station at Shubenacadie and released near Charlottetown. They proved a nuisance to local farmers and were rounded up and transported to eastern Kings County. No further information is available on this herd, but it is known that one buck was killed by an automobile in the autumn of 1951.

About 1953 a report was received by the Department of Industry and Natural Resources stating that a doe with twin fawns had been seen in the Glenwood-Pierre Jacques area in western Prince County.

Apart from these introductions, it is believed that local sportsmen, from time to time, brought young animals over from the mainland. J. S. Jenkins, who furnished the writer with these data, is of the opinion that the doe of the first introduction is now old and barren.

The only known sizable herd is one consisting of seventeen to twenty animals located in the Black Banks-Poplar Grove area of west Prince County. They winter in the numerous cedar swamp areas at the west end of the island.

It is now questionable whether the white-tail will become established on the island. As the wilderness areas are so few, it is unlikely that a large population will build up. Many of the local residents are concerned about the possible effect of the deer on truck gardens and orchards. They have proved very destructive on Cape Breton Island, despite the fact that less than 20 per cent of the land area is under cultivation. In an area where 85 per cent of the land is devoted to agriculture, there is every likelihood that their depredations would prove much more serious.

*Distribution in Region. See Distribution Map No. 26.*

#### **Eastern Moose.** *Alces alces americana* (Clinton)

Bain (1890) states that the moose did not occur on the island at the time of writing but that antlers are occasionally picked up in wooded areas.

*Distribution in Region. See Distribution Map No. 27.*



## THE MAMMALS OF ANTICOSTI ISLAND

The island of Anticosti lies in the western part of the Gulf of St. Lawrence, 40 miles north of the Gaspé Peninsula and 25 miles from the Quebec North Shore. It is 135 miles long and 35 miles wide at its widest part.

Unlike the neighbouring mountainous Gaspé Peninsula, Anticosti is low-lying with no elevation over 500 feet. The land slopes gradually from south to north where benches of from 200 to 300 feet elevation occur. The underlying rocks are composed entirely of limestone laid down in horizontal strata in most areas, although slightly tilted to the southwest in some localities. These flat strata extend out under the sea as broad, level reefs on all sides of the island (Verrill, 1865). At low tide, automobiles can be driven over the reefs almost as readily as on a paved road.

Several low ranges of hills run parallel with the long axis of the island. These are generally heavily wooded with black spruce (*Picea mariana*) and white birch (*Betula papyrifera*). Red maple (*Acer rubrum*) and mountain ash (*Sorbus* sp.) are scattered throughout the spruce and birch woods. Numerous ponds and lakes occur in the valleys between the hills, and here the forest growth is chiefly black spruce. In areas of poor drainage, peat bogs with the associated bog lakes occur. At the east end of the island, an extensive bog extends almost uninterrupted from Southeast Point to Heath Point. Various heath plants such as sheep laurel (*Kalmia latifolia*) and rhodora (*Rhododendron*) cover these bogs. In areas of good drainage, chiefly at the west end of the island, the shallow alkaline soils support a lush vegetation consisting of various wild grasses and herbs and certain shrubs such as wild rose (*Rosa*) and red-berried elder (*Sambucus pubens*).

Because of the thinness of the soil, the trees are shallow-rooted and are frequently toppled by the heavy winds which sweep unimpeded over the island. As pointed out elsewhere in this paper, the plant life growing on soil adhering to the upturned roots of these fallen trees in areas where low vegetation is otherwise lacking, provides suitable habitat for deer mice.

Small lakes and ponds are numerous on the island, and most of them are drained by brooks and rivers flowing south and southwest. The large rivers are the Jupiter, Bescie, St. Marie, La Loutre, Salmon, L'Huile, and Vaureal. Both salmon (*Salmo salar*) and brook trout (*Salvelinus fontinalis*) occur in these rivers and also in the lakes and ponds which they drain. The marl-bottomed lakes support a sparse aquatic and littoral vegetation, which is in part responsible for the scarcity of muskrats and nesting waterfowl.

The climate is similar to that of the adjacent Quebec North Shore. At Mingan, the average annual temperature is 33 degrees F., the average lowest temperature is 24 degrees F., and the average highest temperature



is 42 degrees F. The lowest temperature occurs in February, with an average over a seven-year period of  $-4$  degrees F. and the highest temperature occurs in July with an average temperature of 67 degrees F. August is the month with the heaviest rainfall, the average for the seven-year period being 4 inches. January has the heaviest snowfall with an average, for the same period, of 31.1 inches. The total annual rainfall averages 28 inches, and the total annual snowfall 133.9 inches (Climatic Summaries for Selected Meteorological Stations in Canada, Meteorological Division, Department of Transport, Canada, 1954).

Politically, Anticosti comes under the jurisdiction of the Province of Quebec, but it has been privately owned almost continually since 1860 when it was granted as a seigneurie by the King of France. In 1895 it was purchased by Henri Menier, the French "Chocolate King," for \$125,000. Since the island was intended as a private hunting and fishing preserve, he proceeded to stock it with a number of exotic big game and fur-bearing animals. An imposing chateau was erected near the west end at Port Menier, and each spring Menier and his friends sailed from France on his private yacht, the "Bacchante," to spend the summer and early autumn on the island. A short railway running from the dock to a point 25 miles inland was constructed, which served as a means of transporting supplies and of reaching the interior of big-game hunting. Flat cars were comfortably outfitted with arm chairs, gun racks, and other conveniences for the pleasure of the hunters. The train paused at garbage dumps where black bears congregated. For salmon fishing, special flat-bottomed, horse-drawn river-boats were constructed. Easy chairs arranged under the gay awnings added to the pleasure of the outing. Sport fishing is still an attraction on the larger rivers (Wilson, 1942).

The owner died about 1913, and his brother Gaston inherited the island. It was later sold to a pulp and paper company, which in turn sold it to its present owners, the Consolidated Paper Corporation. At the present time pulpwood cutting operations are carried on at the west end of the island. The company still maintains the island as a wildlife refuge, and hunting is restricted. For many years company employees engaged in trapping, but they no longer do so, since the decline in the price of fox furs. Each year about 500 white-tailed deer are killed for company use.

#### MAMMALIAN FAUNA

Despite its large size and relative proximity to the Quebec North Shore, the island of Anticosti has only five native mammals: Anticosti deer mouse (*Peromyscus maniculatus anticostiensis*), eastern black bear (*Ursus americanus americanus*) Labrador red fox (*Vulpes fulva bangsi*), pine marten (*Martes americana*), and Eastern Canada otter (*Lutra canadensis canadensis*). Thus 80 per cent of the mammal species are carnivores. It is significant that there are no representatives of the Order Insectivora, and only one species of the Order Rodentia. The paucity or absence of species belonging to these orders is characteristic of an island that has had no post-glacial land connections, or one of only brief duration (Matthews, 1952). Geological evidence for or against any post-glacial connection is inconclusive, but both Twenhofel (1912) and Coleman (1942)



indicate that the northern part of the Gulf of St. Lawrence has been undergoing emergence since the retreat of the ice. Actually, the zoological evidence is much more conclusive (See Discussion for details).

It is improbable that the native species colonized the island merely by crossing the narrow Mingan Passage that separates Anticosti from the Quebec North Shore. The direction of the water currents (Figure 8) in the area is such that floating ice or floating debris would be carried either from the St. Lawrence River or the Quebec North Shore east of Natasquan. This probably accounts for the paucity of native species.

Another factor that may account for the small number of native species is the restriction of habitat. The diversity of habitats found in Newfoundland, Cape Breton, or Prince Edward Island, for example, is lacking. In view of the fact that much of the island is today covered by black spruce bogs, it seems probable that in the recent past the entire island was largely semi-barren and therefore unsuitable to many of the species that may have colonized it.

Certainly if few prey species managed to establish themselves on the island and attain a high density, the number of carnivores would be restricted. It may be significant that both the meadow mouse and the ermine are absent from the island.

While only five species of mammals are believed to be native to the island, there is a slight possibility that additional species were present originally but were exterminated by the natives. Jean Alphonse (Baxter, 1906) states that in 1542 there were "bears and porkepickers" on the Isle of Ascension, as Anticosti was then called. It would be remarkable if the porcupine occurred on the island at that time but has since disappeared. It is possible that Alphonse was mistaken in this, as he does not say whether he personally saw these mammals on the island. It may be that he was shown carcasses by the Indians who had brought them over from the Quebec North Shore. The porcupine was highly regarded as a food by the Indian (Jenness, 1955), and it is very possible that a number of these animals were added to their food stores before they embarked on a hunting expedition to Anticosti where game was scarce.

It is, however, impossible to dismiss the possibility that porcupine may have occurred on the island but were exterminated by the Indians. The island population of porcupine would necessarily be restricted, and they can be readily killed with a club. Furthermore, they can be easily tracked in the snow. Since each female bears only one young, the annual increment is small. But if it is assumed that the porcupine did, indeed, occur on the island, it must have been exterminated before 1736 as Father Crespel did not mention it. This he most certainly would have done, had he observed any. It is also significant that there is no evidence of porcupines ever having occurred on the other large islands in the Gulf of St. Lawrence. They are, indeed, now absent from the coastal islands of Miscou and Shipigan on the northeast tip of New Brunswick. It can probably be safely concluded that the porcupine has never occurred on the island.

It is interesting to note that reptiles and amphibians are totally absent from the island (Johansen, 1926b), a fact which strongly supports the



theory that there has been no post-glacial land connection. The wood frog (*Rana sylvatica*), for example, ranges in Ungava as far north as Fort Chimo.

#### PREVIOUS WORK

A. E. Verrill arrived on the island on June 25, 1861, to study its natural history, and remained there until the latter part of August. The results of his study were published in 1865, "Notes on the Natural History of Anticosti." We are indebted to him for information on the species native to the island, as Menier's many introductions of exotic species have made it difficult to determine which are native and which are introduced.

During the period September 15 to October 10, 1936, the Newsom-Watson Expedition of the American Museum of Natural History studied and collected the island's mammals. The results were published by William M. Newsom in 1937.

The writer and his assistant, Marshall H. Ronalds, spent the period June 17 to July 21 inclusive in the area around Port Menier, West Point, and Marten Bay. A good series of deer mice and three grey seals (*Haliochoerus grypus*) were secured—only a few of the seal specimens have found their way into museum collections.

Several of the earlier accounts mention the mammal life. Father M. Crespel (1797) spent the winter of 1736-37 on the island where the ship in which he was travelling to France was shipwrecked. Most of the passengers died, and the few that survived managed to do so by eating bear and fox meat and collecting blue mussels (*Mytilus* sp.) from the seashore. Crespel mentions the red fox, pine marten, otter, and black bear as occurring on the island. There has been some question whether the snowshoe hare is native, but it is remarkable that Crespel did not list it as a food possibility if it were present. He mentions that a family of Indians whom the party contacted in the spring of 1737 gave them "...the meat of the bear, or carabou." Whether this refers to the caribou (*Rangifer*) or is a confusion of terms is not clear from the text. It appears to be the only reference to the caribou as a native species.

Other accounts are those of Wilson (1942) who spent several weeks on a fishing expedition, and Newsom (1941) who, after the publication of his technical report, wrote a popular account of his stay on the island.

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The writer is grateful to Mr. C. G. Savage of the Consolidated Paper Corporation, Montreal, for making it possible to carry on field investigations on Anticosti in the summer of 1952. Thanks are also due to Mr. John Smith, Chief Forester for the island, and Mr. Charles McCormick, formerly Chief Game Warden, for their assistance during the course of the field investigations and for information regarding the mammals of the island. Mr. Marcel Dougay, Lighthouse Keeper at West Point, assisted the field party in many ways, for which the writer is grateful. Dr. D. A. Déry of Quebec City kindly provided information on the introduction of the white-tailed deer to the island.



## ACCOUNTS OF SPECIES

## INTRODUCED:

**American Varying Hare.** *Lepus americanus americanus* Erxleben

*General.* This species is not native to the island according to Verrill (1865). In the winter of 1902-03 Menier liberated 600 animals, which gradually increased and spread throughout most parts of the island. In 1936 they were scarce, according to Newsom (1937), as this was a "low" in their cycle. Again in 1952 they were very scarce; the field party saw only four in a three-week period.

Undoubtedly the introduction of this hare to the island had a profound effect on the density of fur-bearers, as marten increased greatly shortly after the hares became established. Prior to that time, the only mammalian prey available to the predators were the deer mice.

*Distribution in Region.* See Distribution Map No. 8.

## INTRODUCED:

**Canada Beaver.** *Castor canadensis canadensis* Kuhl

*General.* About 1890 forty or fifty beaver were released by Menier. The area from which they were taken does not appear to have been recorded. Beaver now occur along some of the larger rivers, and old beaver workings were seen on a brook east of Cap Caron on July 8, 1952.

*Distribution in Region.* See Distribution Map No. 11.

**Anticosti Deer Mouse.** *Peromyscus maniculatus anticostiensis* Moulthrop

*Taxonomy.* This race is much darker than any of the eastern races of *maniculatus*, and the rostrum is longer than in any of these forms (Moulthrop, 1937). Other, less striking, cranial characters include a narrower interorbital construction, a longer diastema, and a broader braincase. In Figures 1 and 2 the rostral length of *anticostiensis*, *maniculatus*, and *abietorum* is plotted against the total length of the skull. It is evident that the skulls of the Anticosti form differ significantly in this respect from those of the mainland forms. It is also evident that there is a greater similarity between the Anticosti populations and those of the Quebec North Shore than there is between *anticostiensis* and *abietorum*, the race occurring in the Maritime Provinces. This would suggest that the Anticosti mice originated in the Ungava Peninsula and were carried to Anticosti by the Labrador Current which sweeps southwest along the Quebec North Shore, and then swings east along the north shore of Anticosti Island to mingle with the Gaspé Current.

It is interesting to note that there is a close resemblance between *anticostiensis* and *eremus*, the latter form occurring on the Magdalen Islands. This would seem to suggest that either both populations were derived from the same source (the Quebec North Shore), or the Magdalens were colonized by animals from Anticosti. This is quite possible since the Gaspé Current flows eastward from Anticosti and surrounds the Magdalen Archipelago.



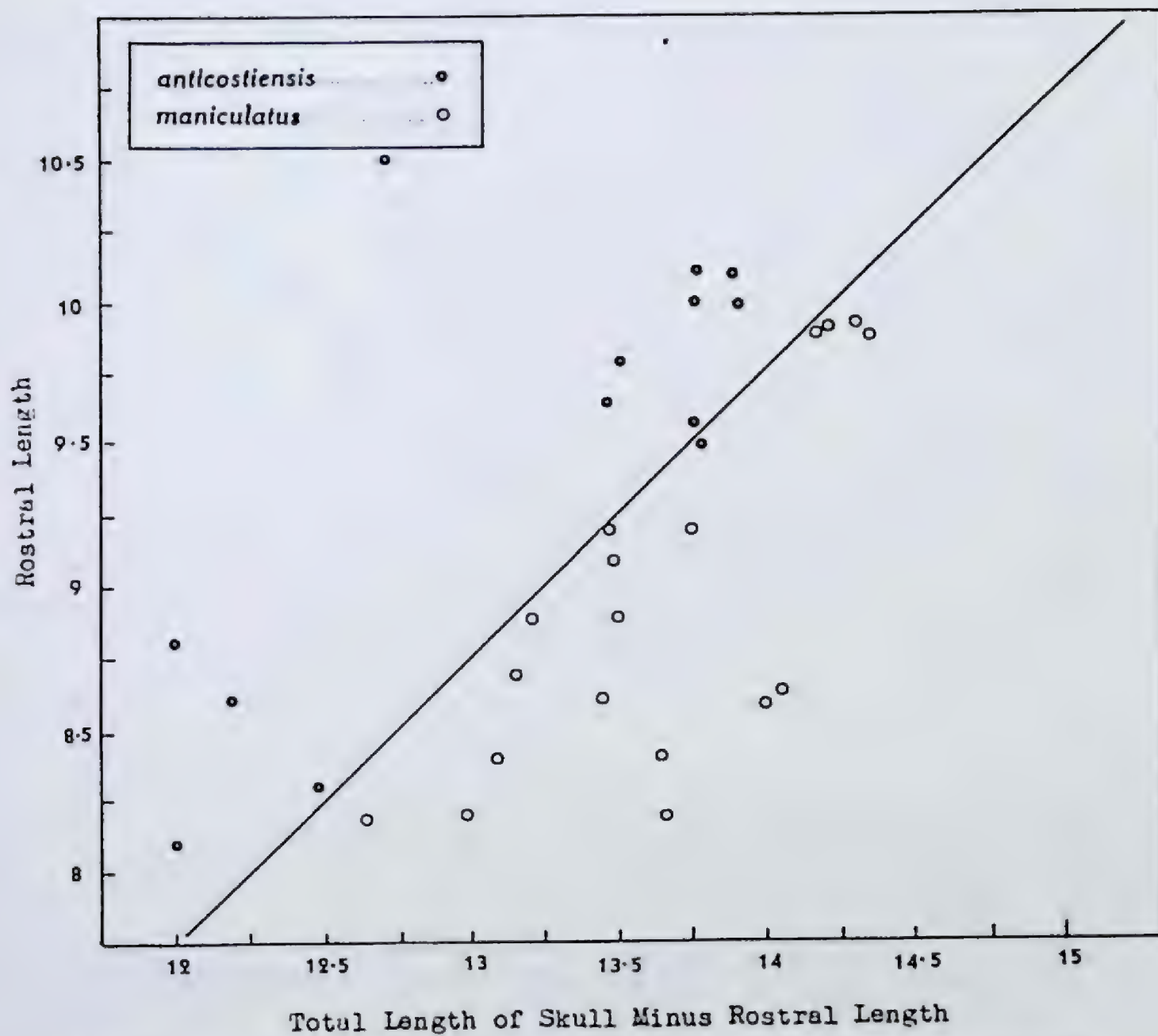


Figure 1. *Peromyscus maniculatus*: *anticostiensis* and *maniculatus*

*General.* The deer mouse is the only small rodent native to the island. While apparently widely distributed, it was rather uncommon in the summer of 1952. Whether this is a general condition is unknown, but the fact that this species is not mentioned by Crespel (1797) or by Verrill (1865) would suggest that it was scarce in 1736 and 1861 when they visited the island. On the other hand, Newsom (1937) reports that it was abundant in 1936. The scarcity evident in 1952 may have been partly due to the lack of suitable habitat, as much of the west end of the island has been extensively lumbered and little natural reforestation of deciduous trees and shrubs has taken place owing to the white-tailed deer. All the accessible young trees and shrubs were so severely browsed that few survived except on the soil adhering to the roots of upturned trees. Here, beyond the reach of the deer, grew a lush assortment of young birches, maples, pin cherries, and mountain ash, and such shrubs as wild honeysuckle (*Lonicera canadensis*), withe-rod (*Viburnum cassinoides*) and red-berried elder (*Sambucus pubens*). It was in such situations that most of the deer mice were taken. A few were trapped under the boards of an old wood cabin.



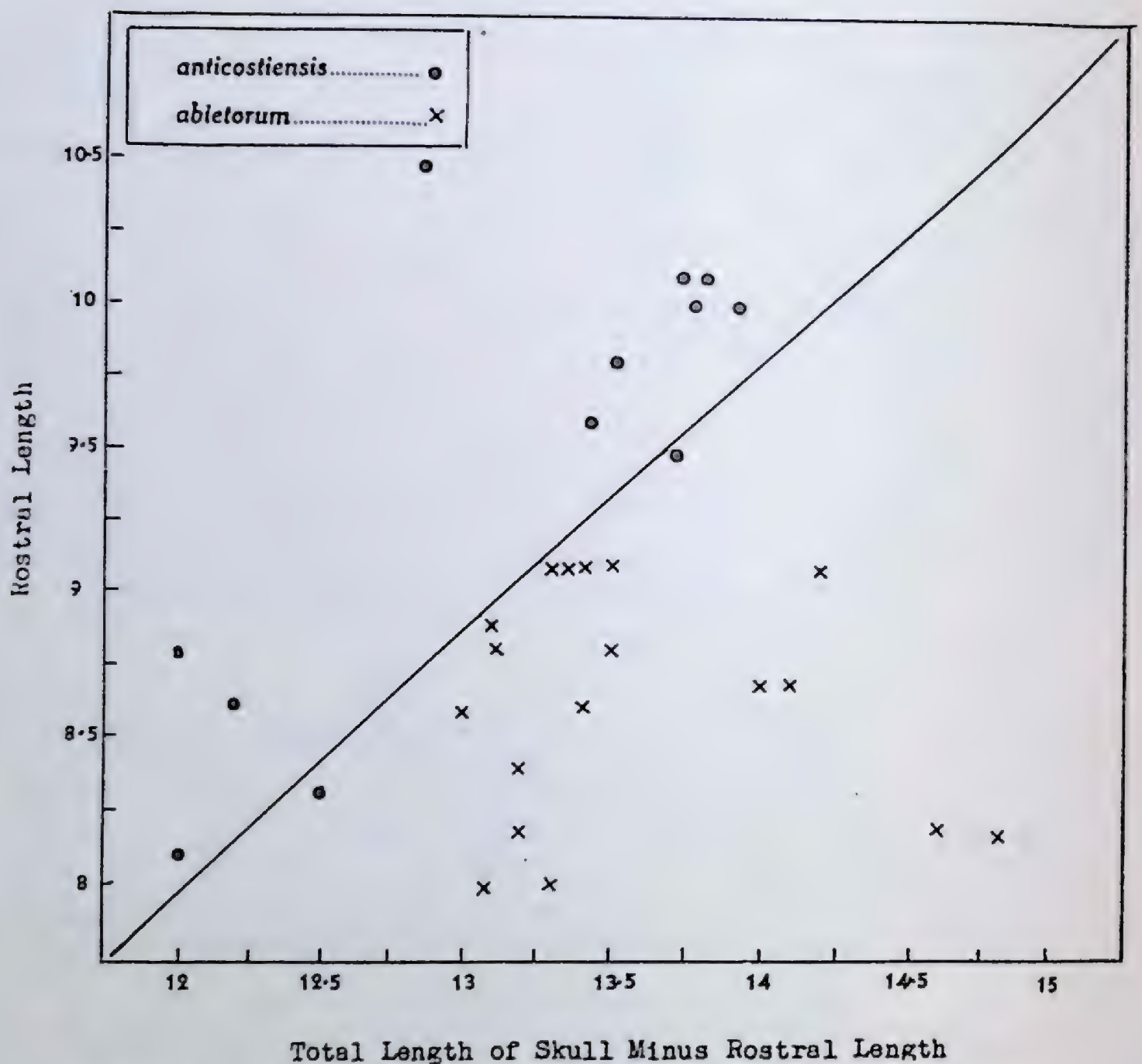


Figure 2. *Peromyscus maniculatus*: *anticostiensis* and *abietorum*

Red foxes were plentiful on the island, and it is probable that they were partly responsible for the scarcity of mice. However, this species is known to be subject to fluctuations in abundance and 1952 may have been a "low" year.

*Specimens.* Marten Bay: 21.

*Distribution in Region.* See Distribution Map No. 12.

#### INTRODUCED:

**Muskrat.** *Ondatra zibethicus* subsp.

*General.* Eleven muskrats were introduced to the island by the Consolidated Paper Corporation in 1930. Although now found in most of the ponds and sluggish streams on the island, the population has not increased appreciably over the years. This is no doubt due to the scarcity of aquatic vegetation, especially cattail (*Typha*), the preferred food of this species. The bottoms of most of the ponds are marl-covered and support a very sparse plant growth. It is not surprising therefore that muskrats and nesting waterfowl are scarce.

*Distribution in Region.* See Distribution Map No. 15.



## INTRODUCED:

**Norway Rat.** *Rattus norvegicus* (Berkenhout)

*General.* The Norway rat is now present around Port Menier and at a number of the lumber camps at the west end of the island. It is neither mentioned by Crespel (1797) as occurring in 1736, nor by Verrill (1865) as occurring there in 1861. However, neither of these authors mentions the native deer mouse; it is possible therefore that the rat might also have been overlooked. But this is less likely since the rat is usually found in the vicinity of habitations. As many fishing boats visited the island even before the time of Jacques Cartier, it would not be surprising if rats were transported to the island at an early date.

These mammals were most in evidence in the vicinity of the older buildings along the waterfront at Port Menier; the density however did not appear to be as high as in most seaports. Perhaps this is because relatively little fishing is done in the area and consequently there is not the abundance of fish offal found in other ports.

## INTRODUCED:

**House Mouse.** *Mus musculus domesticus* Ratty

*General.* The house mouse occurs at Port Menier and at West Point, but the local people reported that it is relatively scarce. Newsom (1937) mentions this species, but neither Crespel (1797) nor Verrill (1865) make any reference to it. Verrill, however, does mention that mice may have been present, but the pressure of other duties made it impossible for him to make any effort to trap them.

**Arctic Fox.** *Alopex lagopus* (Linnaeus)

*General.* This species is evidently an infrequent visitor to the island. Seton (1925) cites two records for Anticosti.

**Labrador Red Fox.** *Vulpes fulva bangsi* Merriam

*Taxonomy.* The red foxes occurring on Anticosti Island are referred provisionally to *bangsi*, although there is a possibility that the original population may have been *rubricosa*. The fox is native to the island, but a number of good quality male silvers were released by the Company with the result that the present population is of mixed derivation. It is now impossible to assign the present population to any subspecies.

*General.* The red fox is native to the island and is mentioned by Verrill (1865) as occurring there in 1861. He was shown a number of red and silver pelts which he states were of good quality. The inhabitants informed him that foxes were plentiful, although he saw none during his two-month visit.

During the period when pelts commanded a high price, the paper company employed about fifty trappers throughout the winter months, and Newsom (1937) states that in the winter of 1936-37 over 1,400 were taken. Of these about 15 per cent were silver, 40 per cent cross, and 45 per cent red. According to J. R. Lindley of the Hudson's Bay Company, the Anticosti foxes are inferior in size and pelage to those of the mainland.



although there is a much larger percentage of patch or cross foxes, which, of course, command a better price than the reds. The cross foxes from the island are generally more prettily marked than those from the mainland.

Company officials carrying on trapping operations were greatly troubled by poachers who operated out of Havre St. Pierre on the Quebec North Shore. With many miles of unsettled coastline, the game wardens had great difficulty controlling this illegal trapping. It also made it difficult for the company to institute any conservation measures since they were unable to arrive at any figure for the annual kill.

Red foxes were abundant in the summer of 1952. The field party saw numerous tracks along the sand dunes and saw foxes almost daily. Of the seventeen foxes seen, two were silvers, five patches, and ten reds. This indicates a fairly high percentage of silvers. The writer has estimated that less than 2 per cent of the foxes on Cape Breton Island are silvers.

Since only one species of mouse occurs on the island and apparently not in large numbers, it is probable that snowshoe hares constitute a fairly high percentage of the food of this fox.

*Distribution in Region.* See Distribution Map No. 17.

### **Eastern Black Bear.** *Ursus americanus americanus* Pallas

*Taxonomy.* There have been, for many years, persistent reports that a species of bear unlike the eastern black bear occurs on Anticosti. Newsom (1937), however, collected on the island one bear that Dr. George Goodwin pronounced to be identical with the black bear of the mainland. Newsom could obtain no information from the woodsmen and trappers on the island to indicate the presence of a different species.

The single skull in the National Collection averages somewhat higher in the hind frontal region than the mainland specimens, but otherwise it appears similar to the nominate race. It is interesting to note that the frontal development should be evident in this specimen, because it is in this character that the Newfoundland black bears differ from those of the mainland.

*General.* This species is native to the island, and Crespel (1797) observed it there in 1736 and Verrill (1865) in 1861. Bears are now uncommon on the island, and the writer was informed that it was highly improbable that he would succeed in collecting a specimen during his stay on the island. However, on July 13, at Marten Bay a sub-adult entered the cabin in which the writer and Ronalds were sleeping, but departed before it could be collected. It is believed to have been attracted by the odoriferous seal skins which were drying near the cabin door.

These mammals frequent the beaches to feed on crustaceans, according to the local people. They may occasionally be seen along the larger rivers fishing for salmon.

Crespel (1797) quotes a Mr. T. Wright, who spent a winter on the island, as saying that bears were extremely numerous and that fifty-three were killed within the space of six weeks, and more could have been killed had the party wished to do so. The same source states that they emerge



from hibernation in April and at once proceed to the seashore to feed "on fish and kelp." Crespel himself lived largely on the meat of bear and fox during the winter of 1736-37 while stranded on the island following a shipwreck.

*Specimens.* One skull collected in 1865, no further data. It may have been collected by Verrill.

*Distribution in Region.* See Distribution Map No. 18.

**Eastern Pine Marten.** *Martes americana americana* (Turton)

*General.* The marten was originally native to Anticosti (Crespel, 1797) and was evidently plentiful in 1861 according to Verrill (1865). Following the introduction of the snowshoe hare in the winter of 1902-03, marten increased tremendously, and it was not unusual for a single trapper to take 300 or 400 pelts in the course of a winter's trapping (Newsom, 1937). Their decline has not been attributed to over-trapping; it is possible they declined at a time when the hare population "crashed" and subsequently failed to increase with the upswing of the cycle. The tracks of this animal were last seen in the Salmon River area in the winter of 1931. It is almost certain that the marten is now extinct on the island.

Rumours to the effect that Anticosti marten differed from those on the neighbouring mainland seem to have no foundation. A Hudson Bay factor, who was located on the Quebec North Shore, stated that Anticosti marten have white paws and a white tip on the tail, but Newsom could find no one among the old trappers who could confirm the story. Marten vary considerably in the amount of pale coloration on the underside of the body which may have led the North Shore trappers to suppose that colour variations in the Anticosti animals were characteristic of the island population.

*Distribution in Region.* See Distribution Map No. 20.

INTRODUCED:

**Fisher.** *Martes pennanti* (Erxleben)

*General.* Menier liberated two fishers on the island, but one died shortly after its release and the other was not seen for more than two years thereafter. There are no fishers on the island at the present time. There appears to be no record of the year in which the introduction was made.

INTRODUCED:

**Eastern Mink.** *Mustela vison vison* Schreber

*General.* Twelve mink were released at the west end of the island by Menier in 1912 (Newsom, 1937). In 1926 they were reported plentiful, but by 1936 they were either very rare or extinct. Charles McCormick informed the writer that none have been seen for many years, and it is believed that they are now extinct on the island. The 1952 field party examined the margins of many brooks and rivers at the west end of the island, but no tracks were seen.

*Distribution in Region.* See Distribution Map No. 22.



**Eastern Canada Otter.** *Lutra canadensis canadensis* (Schreber)

*General.* The otter is native to the island and is mentioned by Verrill (1865) and Crespel (1797). It has never been abundant, but the small population has remained surprisingly stable throughout the years despite continued trapping (Charles McCormick, pers. comm.). Mr. McCormick, who was formerly chief game warden for the island, has never seen a female with more than two young, suggesting a low reproductive rate. Reports indicate that otter are most abundant on the larger rivers which empty into the sea on the island's south coast.

*Distribution in Region.* See Distribution Map No. 24.

INTRODUCED:

**Wapiti.** *Cervus canadensis* (Erxleben)

*General.* In 1903 and again in 1911 wapiti were introduced on Anticosti by Menier. The herds remained in the general vicinity of Port Menier, and the bulls proved dangerous during the rutting season; hence it was necessary to shoot most of them. Mr. Charles McCormick told the writer that three cows remained until the autumn of 1936, when they, too, were killed. At no time following their introduction did the animals cease to frequent the streets of the town and thus they could be shot as readily as domestic cattle.

INTRODUCED:

**Northern White-tailed Deer.** *Odocoileus virginianus borealis* Miller

*General.* White-tailed deer were first introduced on Anticosti by Menier in June, 1896, when fifty were brought to the island on the freighter "Savoy" from L'Ilet, which is about 50 miles below Quebec City on the south side of the St. Lawrence River (Dr. D. A. Déry, pers. comm.). In July of the same year, another fifty were brought over from Cap Chat, which is on the north shore of the Gaspé Peninsula. In 1897, one hundred were released in the summer and an additional twenty in November. Thus a total of about 220 deer were released on the island (Newsom, 1937).

The deer did remarkably well, and in 1952 when the writer visited the island he estimated that the total population could not be less than 350,000, unquestionably the highest density attained by this species anywhere. Their abundance is almost beyond belief. For example, on June 16, while driving by truck from Port Menier to West Point, a distance of 12 miles, no less than twenty-two deer were seen. On June 23, while driving from West Point to Marten Bay, a distance of 36 miles, forty-seven deer were observed. Deer were so abundant at Marten Bay during the three-week period spent there by the field party, that at least two could be observed at any time, even at midday. At low tide, groups of deer would congregate on the exposed reef, presumably to feed on seaweeds. Thirty-four were observed on one occasion on a mile-long stretch of shore. In view of the fact that they have not been subjected to large-scale hunting since Menier sold the island in 1926, they were extremely tame and would allow approach within seven yards without showing alarm. This provided an excellent opportunity to study their food habits and movements.



Because of the high population, there was a general scarcity of food, and the animals were consequently undernourished. In late June, they were in obviously poor physical condition at a time when mainland deer would normally have recovered from the deprivations of the winter. On June 23, more than 90 per cent still retained their winter pelage. It had been reported that Anticosti deer are larger than those on the mainland, but if this were true at one time, it is definitely no longer the case. By July 2, an estimated 80 per cent had acquired the red summer pelage, and by July 10 all deer seen had lost the winter coat.

On June 24 the first tracks of a fawn were noted, but not until July 2 was one actually seen. A total of twenty-two fawns were observed in the period July 2 to July 21. In view of the fact that approximately 300 does had been observed in this period, it would appear that the reproductive rate must be very low. Possibly because of the poor physical condition of the deer, many of the does are barren. No twin fawns were observed, nor were the tracks of twins noted.

According to Newsom (1937), the bucks are late shedding their antlers, a fact that he attributed to their poor physical condition. On September 15, he found that the antlers were still in the velvet. The writer found that in early July, 1952, the antlers consisted of but a single, unbranched stub less than 3 inches long.

It is apparent that deer have increased to the point where there is just barely sufficient food to maintain the population at a subsistence level. Numerous carcasses, the result of a heavy winter kill, were observed in the areas visited.

The trees and shrubs on the island have suffered severely through over-browsing. Practically no young deciduous trees were observed, except those growing on the soil adhering to the elevated roots of upturned trees, where they were out of reach of the deer. Even young spruces were heavily pruned, indicating that the deer are obliged to resort to a food which, on the mainland, is consumed only in cases of emergency (Leopold, 1933). Two does, which spent much of their time in the immediate vicinity of the cabin in which the field party was staying, were frequently observed eating the tender current year's growth of spruces. The deer also fed extensively on tree lichens which on the mainland are ordinarily sampled only sporadically. At low tide the deer congregate on the exposed reefs presumably to feed on seaweeds, a most unusual food for these mammals. While many were observed through binoculars, it was not possible to determine with certainty whether they were eating the seaweeds, but they did spend much time tasting or nibbling something among the rocks. Since biting flies are not plentiful on the island, the concentration of the deer on reefs cannot be attributed wholly to escaping from these nuisances.

There has been no large-scale hunting on the island since it was sold in 1926. Each year about 500 are killed for the use of the employees. In 1954 permission to hunt deer was granted to a limited number of outside sportsmen.

Since the white-tail is an introduced species, no specimens were collected by the 1952 field party.

*Distribution in Region. See Distribution Map No. 26.*



## INTRODUCED:

**Eastern Moose.** *Alces alces americana* (Clinton)

*General.* Between 1895 and 1913 a total of twenty moose were released on the island, chiefly in the area around the Jupiter River. McCormick (pers. comm.) placed the population in 1952 at about 250. A young moose was observed by the writer on July 12, 1952, at Marten Bay. Considering the heavy deer population, it is remarkable that the moose has been able to survive.

*Distribution in Region.* See Distribution Map No. 27.

**Lapland Reindeer.** *Rangifer tarandus tarandus* (Linnaeus)

*General.* About 1920, between 245 and 260 reindeer were brought from Lobster Bay, Saguenay County, Quebec, and released at the west end of the island. In 1930, the herd had shrunk to twenty-six or twenty-seven animals, and only seven young were born in the first two years. No yearlings were observed. The lack of suitable forage is believed to have been responsible for their rapid decimation. They did not thrive and are now believed to be extinct on the island. According to Mr. Charles McCormick (pers. comm.) two animals were reported seen at the east end of the island in 1949.

## INTRODUCED:

**Bison.** *Bison bison bison* (Linnaeus)

*General.* In 1896 several bison were released at the west end of the island, but they died within a few years. A further attempt was made to introduce this species a few years later, but without success. It is interesting to note that the local people have had indifferent success with raising cattle and sheep, although horses do reasonably well. The shallow soil is unsuited for hay crops, and in dry years the grass cover in the few clearings that have been made is wilted by late July.



## THE MAMMALS OF THE MAGDALEN ISLANDS

The Magdalen Island Archipelago is a low crescent-shaped chain of islands situated in the south-central part of the Gulf of St. Lawrence between 47° and 48° north latitude. The entire group is approximately 60 miles in total length with the long axis running roughly in a northeast-southwest direction. The northeast extremity of Prince Edward Island, 54 miles distant, is the nearest land mass; Cape North at the northernmost tip of Cape Breton Island is 60 miles from the northeast extremity of East Island. Fifteen islands make up the archipelago, of which nine are more or less connected by sand dunes: Amherst, Grindstone, Alright, Wolf, North Cape, Northeast Cape, East, Coffin, and Grosse Isle. The isolated islands include Entry, Deadman, Shag, Brion, Bird Rock, and North Bird. In addition to the sand dunes which surround the islands, sand bars extend out to sea in various directions, in many cases enclosing broad, shallow lagoons. The total land area, exclusive of the sand dunes, is estimated at less than 50,000 acres. The human population is in excess of 10,000 making the Magdalens one of the most densely populated rural areas in the world. The land is gently rolling with conical hills, which occur on most of the islands, rising to a height of from 300 to 500 feet and termed the "demoiselle hills" by Clarke (1911). "Sink-holes" occur in areas where the underlying rock consists of gypsum and limestone.

Both sedimentary and igneous rock formations on the archipelago were laid down in Mississippian time when the region was undoubtedly covered by a shallow area. Calcium carbonate and calcium sulphate were precipitated out to form the limestone and gypsum beds. At the same time, volcanic outbursts scattered fragments and ashes among the sediments where they occur in varying amounts (Alcock, 1941).

Whether or not the Magdalen Islands were glaciated, geologists disagree since there is no evidence of glacial erosion. However, Alcock (1941) points out that glacial deposits occur abundantly at various points on the archipelago, including a morainal ridge on Coffin Island made up of boulders and pebbles consisting of granite, banded gneiss, and amphibolite, all typical Precambrian rocks from the Labrador Peninsula.

Prest (pers. comm.), however, has been unable to find any conclusive evidence of glaciation. He is of the opinion that an arm of the sea may have extended westward from the Atlantic Ocean during the glacial period and surrounded the archipelago. If the sea-level was lowered during Wisconsin glaciation as a result of water being bound up in ice, the archipelago probably had a considerably greater land area than is now the case. However, the area would be surrounded by ice-fields and would lie within what Deevey (1949) calls a "peri-glacial" climate. There seems to be no reason to believe, therefore, that any terrestrial animals survived in the area during glaciation.

As a result of the archipelago's maritime location, its climate is equable. The following climatic data for Grindstone covers a 17-year



period: average annual maximum temperature, 45°F.; average annual minimum temperature, 16°F.; average lowest temperature for the year (February), -19°F.; average highest temperature for the year (August), 68°F.; average annual rainfall, 27.55 inches; average annual snowfall, 116.6 inches.

The archipelago is politically a part of the province of Quebec.

#### MAMMALIAN FAUNA

Of the four species of mammals occurring on the archipelago, possibly only the deer mouse (*Peromyscus maniculatus eremus*) is native. The red fox (*Vulpes fulva*), snowshoe hare (*Lepus americanus struthopus*), and meadow mouse (*Microtus pennsylvanicus*) may have been introduced. It is possible that Arctic foxes (*Alopex lagopus*) and polar bear (*Thalarctos maritimus*) were occasional visitors until recent times, because Cartier (Baxter, 1906) states in his annals that he saw "bears and foxes" on June 25, 1534, on Brion Island. Then again these may have been red foxes and black bears, although considering the restricted land area, it would be remarkable indeed if the latter were native to the Archipelago. On the other hand, these mammals succeeded in colonizing the other four large islands in the Gulf; perhaps, therefore, it should not be surprising if they had reached the archipelago, though it is difficult to imagine their being permanent residents.

It has not been determined whether the meadow mouse is native or has been brought to the island within recent times. As quantities of hay are imported each year from Prince Edward Island, these mice could easily have been carried in in large shipments. On the other hand, it is remarkable that the only evidence of mice noted was in a cranberry bog. No signs were noted in the adjacent hayfields where one would expect them to become established.

Deer mice occur at least on Grindstone Island, and probably on Amherst Island where scattered patches of woods occur. From the collector no data are available regarding the type of habitat in which the nineteen specimens collected were taken. The matter bears further investigation.

Unfortunately very little is known about the taxonomy, distribution, or population fluctuations of the snowshoe hare on the archipelago. Since only 78 square miles of the total land area is soil-covered, it is obvious that the hare population cannot ever be great, even in peak years, and that probably, in the trough of the cycle, the population may consist of only a few hundred animals. The archipelago should provide excellent opportunities for studies of cyclic fluctuations in this species, in comparison with similar studies conducted on the mainland.

The red fox (*Vulpes fulva*) is frequently observed by the local residents; possibly it breeds. There may be a resident population, but stray animals may reach the islands by crossing on the ice in winter. There is also the possibility that foxes were introduced on the archipelago by residents in an attempt to ranch them.

Cartier mentions in his journals that walrus were plentiful on Brion Island in 1534. Grey (*Haliochaerus grypus*) and harbour (*Phoca vitulina*) seals occur around the coasts in summer, and harp seals (*Phoca groenlandica*) occur on the ice-floes during the winter months.



## FIELD STUDIES

The writer and Marshall H. Ronalds spent the period August 20 to September 8, 1952, on the archipelago. Otherwise no mammalogical field parties have visited the islands. A few specimens have been collected by visitors engaged in other pursuits.

## ACCOUNTS OF SPECIES

**Nova Scotia Snowshoe Hare.** *Lepus americanus struthopus* Bangs

*Taxonomy.* A single specimen, collected at Grosse Isle on July 1, 1901, was the only material available to Nelson (1909) when he made his revisions of the genus *Lepus*. He states that in colour it cannot be distinguished from the nominate race, but the skull is that of *struthopus*.

*General.* In the summer of 1952 snowshoe hares were evidently very scarce on the archipelago, as the field party saw none and found no definite trails. The local people reported a general scarcity in the three preceding years.

On July 1, 1901, W. E. Clyde Todd collected one specimen on Grosse Isle and reported that he saw many others during his stay there. However, in 1907, W. H. Osgood spent ten days on the archipelago, but, despite every effort to secure specimens, he failed to see even a single animal. Varying hares were scarce throughout most of Canada in 1907, and the decline seems to have likewise affected the Magdalens. This is the only definite information available on fluctuations of the snowshoe hares on the islands.

While there is no information concerning the introduction of this species to the islands, probably the species was released there by the early settlers. It would be remarkable if this hare is native to the archipelago, which is over 50 miles from the nearest land mass; whereas in Anticosti and Newfoundland it is non-native, though these islands are relatively close to the mainland. However, it is mentioned by Cory (1878).

*Specimens* (Carnegie Museum). Grosse Isle: 1.

*Distribution in Region.* See Distribution Map No. 8.

**Magdalen Islands Deer Mouse.** *Peromyscus maniculatus eremus* Osgood

*Taxonomy.* This form is almost intermediate in colour between *maniculatus* of Central Quebec and *abietorum* of the Maritime Provinces (Osgood, 1928). Cranially, it may be separated from all other subspecies by the large foramen magnum. In many respects it approaches *anticostiensis*, particularly in possessing the U- or V-shaped interpterygoid fossa. The rostrum is somewhat shorter than in *anticostiensis* but longer than in *maniculatus* or *abietorum* (Moulthrop, 1937).

*General.* The Magdalen Islands deer mouse appears to be closer to *anticostiensis* than to any other form, and both *eremus* and *anticostiensis* appear closer to *maniculatus* than to any other mainland race. This might suggest that the first colonizers of the archipelago originated on the Quebec North Shore or on Anticosti Island. It also suggests that the Labrador and Gaspé currents were responsible for carrying the colonizers from the Quebec North Shore or Anticosti Island, or both. It is interesting that



the deer mice inhabiting this island group should show greater similarity to those of the Quebec North Shore, 150 miles distant, than to the deer mice of Prince Edward Island, which is only 54 miles distant. As has been suggested elsewhere in this report, it is quite possible that the Magdalens were colonized by animals originating in Anticosti.

Unfortunately the writer did not obtain specimens of this species during the ten-day period spent on the archipelago.

*Specimens* (United States National Museum). Grindstone Island: Pleasant Bay, 19.

*Distribution in Region.* See Distribution Map No. 12.

**Acadian Meadow Mouse.** *Microtus pennsylvanicus acadicus* Bangs

*General.* Until the writer and his assistant, Marshall Ronalds, visited the archipelago in 1952, the occurrence of the meadow vole there was not known nor suspected. It therefore was most surprising when runways, obviously made by a small rodent, were observed meandering among the hummocks of a cranberry bog on Amherst Island near Havre Aubert. It was known that the deer mouse (*Peromyscus*) occurred on the archipelago, but clearly the runways were not made by this animal, which is a woodland species whose runways are not obvious. On the other hand, it seemed rather unlikely that meadow mice occurred in the bog since there was no evidence of them in hayfields on either Amherst or Grindstone islands. On the mainland this species occurs during peak years in relatively dry bogs, though the writer has found no evidence of meadow mice locating in bogs when the population has been low and when few or none occur in fields, meadows, and other grassy areas.

Subsequent trapping revealed the presence of a small population of meadow mice in the bog. A total of six specimens were secured in the six-day period.

*Specimens.* Havre Aubert: 6

*Distribution in Region.* See Distribution Map No. 14.

**Red Fox.** *Vulpes fulva* (Desmarest)

*General.* The red fox appears to be resident on the archipelago and presumably breeds there, but whether it is native or introduced is unknown. Cartier (Baxter, 1906) states in his journal that he saw "bears and foxes" on the island, but there is a slight possibility that the foxes he mentions were of the Arctic species. Cory (1878) states that foxes were common on the islands in 1876 suggesting that they may be native. It is not impossible that they reached the islands on ice-floes as they colonized all the other islands in the Gulf. The taxonomic status of this insular population bears study.

*Distribution in Region.* See Distribution Map No. 17.



## THE MAMMALS OF NEWFOUNDLAND

Situated at the most easterly part of the North American continent, the island of Newfoundland lies across the Gulf of St. Lawrence. It is separated from Ungava by the Strait of Belle Isle, which is 11 miles wide at its narrowest point. The 70-mile-wide Cabot Strait separates it from the Island of Cape Breton.

Newfoundland is roughly triangular in shape and has a total area of 42,700 square miles. The coast is highly irregular with numerous inlets and bayheads; in relief it may be described as a plateau of rolling hills, which slope gradually from the height of land on the west coast to a low and relatively level plain in the region of the Avalon Peninsula.

As a result of recent geological studies in Newfoundland, it has been concluded that the island was entirely glaciated (Twenhofel and McClintock, 1940), in spite of the fact that Fernald (1925) found certain plant species that he believed represented relicts from a pre-glacial period. On this basis it was necessary to postulate the existence of refugia in which these plant species survived. Brooks and Brooks (1940) in their study of the endemic mollusca also concluded that certain forms must have survived glaciation. As will be shown later, a study of the mammalian fauna seems to lend support to the view that the island was at least glaciated to the extent that mammalian life was unable to survive the glacial period. Even if certain areas were ice-free, it is doubtful if mammals could have survived in them (Deevey, 1949).

The climate of Newfoundland is marine in character, although modified by the cold Labrador Current that flows along both the east and west coasts. The climate is further tempered by the prevailing northwest winds that sweep down from Ungava. The winters are long and relatively cold, and the summers are cool with a mean temperature of 60°F. The mean January temperature at St. John's is about 23°F., and at the Strait of Belle Isle 9°F. In general, the west coast has greater extremes of temperature than the east.

Annual mean precipitation is in excess of 30 inches with rainfall heaviest on the east coast, where there is the greatest amount of fog.

Newfoundland lies within the Boreal Coniferous Forest Region and has a forest cover not unlike that part of the eastern Canadian mainland in the same latitude. The more important species in so far as relative abundance is concerned are black spruce (*Picea mariana*), white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), white birch (*Betula papyrifera*), and yellow birch (*Betula lutea*). Such species as larch (*Larix laricina*), white pine (*Pinus strobus*), red maple (*Acer rubrum*), and poplar (*Populus* sp.) are of lesser importance, though they are often quite abundant locally.

For the sake of convenience the forest cover may be roughly divided into three subdivisions: (i) valley slopes, (ii) barrens and hill tops, (iii) valley floors and swamps. The well-drained valley slopes support a cover



of balsam fir, white spruce, black spruce, and white pine. Characteristic understory plants include bunch berry (*Cornus*), snake berry (*Clintonia*), blue-berry (*Vaccinium*), and sheep laurel (*Kalmia*). It is on these slopes that the trees attain maximum development.

The tops of the higher hills and the edges of the barrens are forested mainly with black spruce, though balsam fir may also occur where conditions are favourable. Since the soils in such situations tend to be acidic, the understory consists largely of ericaceous plants, as, for example, Labrador tea (*Ledum*) and sheep laurel (*Kalmia*). Pigeon berry (*Cornus*) also occurs in such acid conditions. On the drier, more exposed parts of the barrens the ericaceous plants give way to reindeer moss (*Cladonia*) and various other lichens.

In swamps, valley bottoms, and other areas of poor drainage, black spruce is the dominant tree with an understory of sheep laurel (*Kalmia*) and Labrador tea (*Ledum*). In some sections larch may also occur.

The island is plentifully sprinkled with numerous ponds and lakes, many of which, through the normal process of silting, have been converted to bogs and swamps where the dominant vegetation consists of ericaceous shrubs, though various sedges (*Carex*, etc.) sometimes occur, especially in ponds where there is water movement. The ponds and lakes themselves are vegetated with various aquatic plants, such as yellow pond lily (*Nymphaea advena*), white water lily (*Castalia*), pond weeds (*Potamogeton*), wild celery (*Vallisneria*), and duck weed (*Lemna* sp.).

Much of the low-lying land along the courses of brooks and rivers is marsh-like in character. Here, many hydrophilous species of herbs, grasses, and sedges constitute the dominant flora: marsh marigold (*Caltha palustris*), blue flag (*Iris*), and blue-eyed grass (*Sisyrinchium*).

Most of the ponds and lakes on the barrens are rocky and largely unvegetated, although the yellow pond lily (*Nymphaea advena*) occurs in many of them. Where there is some water movement, wild celery (*Vallisneria*) sometimes occurs. The littoral vegetation is very sparse and in most cases consists of sedges and cotton grass flanked by a rank growth between the ericaceous shrubs and the water's edge.

#### MAMMALIAN FAUNA

Fourteen species of mammals were originally native to Newfoundland, five have been introduced by man, and two are infrequent visitors from northern Canada. Of the fourteen native species, no less than ten are represented by endemic subspecies. Of these forms peculiar to the island, one, the Newfoundland wolf, is now extinct; and two, the pine marten and the Arctic hare, are rare, although formerly abundant. The lack of an adequate series of specimens makes a thorough review of the validity of all the named forms difficult, but statistical analyses of cranial variations in four species have shown that they are well marked. Striking colour differences between the insular and mainland forms are apparent in five of the species for which cranial measurements are not available. In all cases, the insular subspecies differ more radically from other races of the species than do most of the mainland subspecies from one another.



In order that such well-defined subspecies could have evolved in the relatively short time since the retreat of the last ice-sheet, it is necessary to assume that the island was colonized shortly after it became habitable and that there were very few, if any, colonizations since. It is also highly probable that the original colonization consisted of very few individuals, thus accounting for the rapid rate of subspeciation, since inbreeding would result in greater homozygosity. Also, colonization by very few individuals would probably result in gene loss.

While it is possible that the subspecies now occurring on Newfoundland evolved on the mainland and subsequently spread to the island, this seems unlikely. Had they arisen on the mainland, it would be necessary to account for their absence there at the present time. It could be argued that they might have been replaced or absorbed by northward spreading races from farther south or west. If this has occurred, however, the same subspecies should occur on all the islands; whereas, in actual fact, each island has its own race. Furthermore, most of the insular races show no greater similarity to one another than they do to races occurring on the mainland.

The various means by which the mammals reached the islands is treated at some length in the "Discussion" of the present report. Floating ice, vegetated moraines, floating debris, and ice-borne areas of vegetated soil are all considered as possibilities. Since there are no true hibernators on the island, it seems probable that colonization occurred during the winter months, when floating ice assisted in the immigration. Introduction of these mammals by the aborigines is considered unlikely.

It is interesting to note that several of the races, e.g., the meadow mouse and otter, are morphologically more similar to the forms occurring in the Maritime Provinces than to those found in nearby Ungava. It is also noteworthy that anthropologists consider the Beothuk Indians of Newfoundland to be culturally closer to the Micmacs of Nova Scotia than to the Montagnais or Naskapis of Ungava (Jenness, 1955). The Ungava tribes do not appear to have visited Newfoundland, though the Micmacs crossed the turbulent Cabot Strait by canoe. The immigration was particularly marked during the period when the government placed a bounty on the native Beothuks. The Eskimos are known to have resided in northern Newfoundland for various periods, but they did not interbreed with the Indians there. Perhaps this is not surprising since the Eskimos and Indians of today rarely intermarry.

In several races, striking changes in habitat preferences are apparent. The meadow mice occur throughout the forested areas on the island, possibly as a result of the absence of closely related competitive forms or possibly because grasslands are very much restricted. Prior to the introduction of the snowshoe hare, the Arctic hare, normally a barren-ground species, occurred throughout the forested regions. It is now restricted to the upland barrens where the snowshoe hare is unable to compete. A population of beaver may be restricted to the barrens where they live in the bog lakes and subsist on the roots of water lilies. Attempts to establish



them in forested areas have been unsuccessful. The Newfoundland caribou, a member of the woodland complex, is largely an animal of the barren-ground and in this respect resembles the barren-ground caribou of the Arctic.

In general, the pelage of the Newfoundland subspecies is more highly pigmented than corresponding races on the mainland. This can probably be attributed to the higher humidity (Bachrach, 1946). Size differences may be largely environmental as in the case of the muskrat, which is smaller than mainland races.

Although the green frog (*Rana clamitans*) was successfully introduced on the Avalon Peninsula in 1922 (Johansen, 1926b), Newfoundland has no native reptiles nor amphibians. All the freshwater fishes, such as brook trout, Atlantic salmon, American eel, killifish, and the stickleback, are anadromous (Johansen, 1926a). The ruffed and spruce grouse are absent, but the willow and rock ptarmigan occur (Peters and Burleigh, 1951).

#### PREVIOUS WORK

Hitherto no previous comprehensive study of the mammals of the island has been undertaken. Dr. Outram Bangs of Cambridge, Massachusetts employed a trapper, Ernest Doane, to collect specimens on the island during the period 1889 to 1912. Dr. Bangs' descriptions of forms peculiar to Newfoundland are based on these specimens, most of which are now at the Museum of Comparative Zoology, Cambridge, Mass. The Newfoundland Department of Mines and Resources is now engaged in studies of the economically important species.

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#### ACCOUNTS OF SPECIES

##### **Little Brown Bat.** *Myotis lucifugus lucifugus* (LeConte)

*General.* This species was observed by the writer in 1949, 1950, and 1951 in numerous localities throughout the island: St. John's, Salmonier, Deer Lake, South Brook, Corner Brook, Doyles, and Tompkins. None, however, were seen at Port Saunders in 1950, but the local residents



reported having seen them in previous summers. The month of July was cold and wet which may be responsible, in part at least, for the fact that no bats were seen.

The little brown bat and the long-eared bat are very similar, and it is difficult to make identification unless the animal is in the hand.

*Specimens.* Humber District: South Brook, 6; St. George's District: Doyles, 5.

**Eastern Long-eared Bat.** *Myotis keenii septentrionalis* (Trouessart)

*General.* Of the thirteen specimens of bats collected by the National Museum of Canada field parties, two were eastern long-eared bats. Both were taken rather late in the evening, about two hours after sundown. One was captured in a shed; the other was shot while flying low along the ground in an open hayfield.

Apart from the specimens collected in 1950, the Museum of Comparative Zoology has four specimens from the following localities: Lewis Mills, 2; Romain's Brook, 1; Spruce Brook, 1 (Miller and Allen, 1928).

*Specimens.* St. George's District: Doyles, 2.

**Arctic Hare.** *Lepus arcticus bangsii* Rhoads

*General.* The Newfoundland hare is the only member of the order native to the island. Originally it occurred throughout the wooded parts of the island but is now restricted to the higher and barren hills. Tocque (1878) states that it occurred "...in great numbers on the west and north coasts of the island." Cormack (1823) mentions that it was a common species at the time of writing. Local residents on the island told the writer that as children they recall their grandparents talking of snaring the "mountain hares" around the fishing villages. Now these hares are so scarce that few island residents have seen one, and many are unaware of their existence.

The introduction of the snowshoe hare from Nova Scotia seems to be responsible for the present restriction of the Arctic species. Howell (1936) quotes James P. Howley, then Director of the Newfoundland Geological Survey, as saying that undoubtedly the snowshoe hares have "...driven out the large Arctic hares, once fairly plentiful in most parts of the island, but now only to be found on the highest and barest uplands, which do not afford food or shelter for the rabbits (*Lepus americanus struthopus*). The former are now quite rare." Doane, as quoted by Bangs (1913), stated that the Arctic hares descend in winter to the open plains but no longer enter the woodlands.

This appears to be a clear-cut example of one species replacing another through competition. That the Arctic hare reaches its most southerly extension in North America on the island of Newfoundland is interesting and may suggest that its northern distribution is the result of competition with the snowshoe hare and that in the absence of this species the Arctic hare would range much farther south in Canada than is now the case. A somewhat parallel example is found in the British Isles where the mountain hare occurs throughout the highlands and lowlands of Ireland but is found only on the mountain tops in Scotland and is replaced



at lower altitudes by the closely related common hare (Lack, 1944). In either case, the exact nature of the competition is not known, though it is quite possible that food is an important factor.

Before the introduction of the snowshoe hare, Norway rat, and house mouse, the Arctic hare probably constituted an important part of the food of the pine marten and lynx. There must have existed, therefore, a much more intimate predator-prey relationship than generally is to be found among mainland communities of mammals.

*Specimens* (Mus. Comp. Zool.). Humber District: Bay of Island, 1; St. George's District: Bay St. George, 1; Codroy, 2; Gaff Topsail, 1; Mount St. Gregory, 1; Avalon Peninsula, 5.

*Distribution in Region.* See Distribution Map No. 7.

#### INTRODUCED:

**Nova Scotia Snowshoe Hare.** *Lepus americanus struthopus* Bangs

*Taxonomy.* Nelson (1909) examined three skins of this race from Newfoundland and found that the tops of the feet and the ears in the winter pelage were overlaid with a bright cinnamon buff, and the fur of the body was so lightly overlaid with white that the underlying cinnamon showed through. In skull characters he found that the Newfoundland specimens differed from those in Nova Scotia in that the rostrum was more slender. He states, "Although these animals were introduced into Newfoundland from Nova Scotia, they appear already on the way to the formation of a distinct subspecies." This brownish coloration of the winter pelage may be genetic or it may be environmental as a result of the milder climate in Newfoundland. It would be desirable, however, to compare large series of specimens from both Newfoundland and Nova Scotia, because a genetic change, even in such a short period of time, is not impossible (Degerbøl, 1940).

*General.* According to Howell (1936) this species was introduced into Newfoundland about 1864 by the Hon. Stephen Rendell. Tocque (1878) evidently was not aware of the introduction as he definitely states that this animal did not occur on the island in 1876. Game officials suspect that there may have been several introductions at the close of the last century. Hatton and Harvey (1883) state that "A few years ago a few pairs of the common North American hare were brought from Nova Scotia and let loose in the vicinity of the capital (St. John's). They have thriven and increased rapidly . . . ." Whether this refers to the introduction made by Rendell is not clear.

Whatever may have been its origin or origins, the snowshoe hare has multiplied rapidly and is now found in almost all the wooded parts of the island. Apparently it is subject to violent periodic fluctuations as game officials received many reports of dead rabbits having been found in the spring of 1946. The 1949 field party found hares quite scarce, though the presence of well-marked trails indicated previous abundance. They were again scarce in 1950 when the party was located in the Port Saunders area. Local residents reported that a decline had occurred three or four years previously. The decline was blamed on red foxes, which were



abundant in the area in 1950, but the fact that the decline was widespread, not only in Newfoundland but on the mainland, made it quite evident that predator pressure alone could not be responsible.

The consensus among island residents is that the introduction of this species was of the greatest economic importance. Statistics maintained by the game officials of the island show that this animal provides more wild meat than all other game species combined. In the fiscal year 1944-45, for example, 46,160 hares were canned for future use. This does not take into account those immediately consumed.

Unfortunately, practically no information is available on the cyclic fluctuations of the hare on the island. The earliest recorded closed season is that of one imposed on April 20, 1859, which states that snowshoe hares may not be taken during the period April 23 to August 20, inclusive. This perhaps suggests that a decline occurred the previous winter. Unfortunately Newfoundland was included in only one of the annual surveys of animal fluctuations conducted by Oxford University.

*Distribution in Region.* See Distribution Map No. 8.

#### **Newfoundland Beaver.** *Castor canadensis caecator* Bangs

*Taxonomy.* The beaver of Newfoundland was described as a distinct species, *caecator*, by Bangs in 1913. Subsequently in 1942 Allen reduced it to a subspecies of *canadensis*. Allen, however, made no direct comparisons between the Newfoundland populations and those on the mainland. In his original description, Bangs states that the Newfoundland beaver is similar to the nominate race but slightly smaller, with several differentiating characters such as wider interparietals, zygoma lighter and less flaring, nasals shorter and wider, and incisors yellow instead of orange, as in *canadensis*.

The writer examined four skulls at the National Museum of Canada, collected in 1950, and a series of nine specimens in the Bangs collection at the Museum of Comparative Zoology. From this study it was apparent that the shape of the zygoma is the most important character separating the Newfoundland form from other races of the species. In the case of *caecator*, the arches are definitely straight in contrast to the evenly bowed arches of the nominate race. The other characters mentioned by Bangs are much less striking. The incisors are only slightly paler in *caecator* than in *acadicus* (Maritime Provinces) and *canadensis* (central Canada), and the difference is not striking. The interparietals are very variable in shape and are of doubtful value as taxonomic characters. Apart from the shape of the zygomatic arches, the width of the nasals seems to be the best differentiating character. The mean width of twelve skulls of *caecator* is  $22.6 \pm .33$ , and of eight specimens of *canadensis* and *acadicus* is  $18.5 \pm .55$ . The nasals of the Newfoundland race are, therefore, somewhat broader. Despite the slight differences in other characters, the unusual shape of the zygoma in itself is sufficient to warrant the recognition of the Newfoundland population (Figure 3). In fact, it would seem to indicate that the beaver of Newfoundland have gone a long way in morphological differentiation, perhaps almost approaching the species threshold.



Examination of a series of skins, including three collected by the National Museum of Canada field parties, reveals that the Newfoundland beaver averages slightly darker than those from the neighbouring mainland.

In view of the fact that the Newfoundland beaver resembles the forms occurring on the mainland in most respects, it seems unwise to accord it full specific status. Mayr *et al.* (1953) consider it unwise to describe an allopatric form as a distinct species unless it differs in many respects from other closely related forms. There are no data on the degree of inter-fertility between the island and the mainland forms, and even if breeding in captivity were successful, there is no guarantee that the animals would normally do so in nature (Carter, 1951).

It is of interest to note in this connection that presumably there is a population of beaver on the island that normally live on the barrens. These may represent a form of ecological differentiation arising perhaps from the fact that when the beaver first colonized the island, the forested areas were very restricted indeed.

*General.* The beaver is native to the island and is mentioned by such early writers as Cormack (1823), Bonnycastle (1842), and Tocque (1878). Millais (1907) refers to the beaver in his chapter on the Micmac Indians, and Dugmore (1913) discusses the food habits of this species living on the barrens.

One of the first reliable accounts regarding the status and habits of the beaver on the island is contained in Cormack's "Journey Across the Island of Newfoundland in 1822" (1823). He states that although beaver were quite plentiful prior to 1822, their numbers were seriously reduced by the Indians (presumably the Micmacs).

From the time the Micmacs from Nova Scotia and the whites arrived on the island, until about 1905, beaver showed a continual decrease until about 1910 when they were virtually exterminated. Only a few colonies survived on the Avalon Peninsula and at a few isolated points in the interior. Since that time there has been a gradual increase.

At present, beaver are generally distributed throughout most parts of the island. Through rigorous government protection, the population has been built up with the result that beaver now occur in areas where they have been unknown for almost a century. Captain H. W. Walters, for many years Chief Game Warden, took steps to restock areas that had been trapped out. A continued closed season was in operation for many years, and when it was finally opened in 1946 the Newfoundland government took over the purchase and sale of pelts, thus imposing a firm control over the numbers that could be taken. The pelts were sold as a lot, and, provided the skins were properly prepared, an equal amount was received by each trapper for his pelts, regardless of size or grade. This system had the added advantage of enabling the government to obtain a fairly accurate count of the number of animals taken annually and thus to regulate more wisely the length of the open seasons and the number of animals that could be taken. From the point of view of the trapper also, it appears to be about the fairest method that can be used. If the limit is three beaver per trapper, he should not be discriminated against if unfortunate enough to trap three kits.



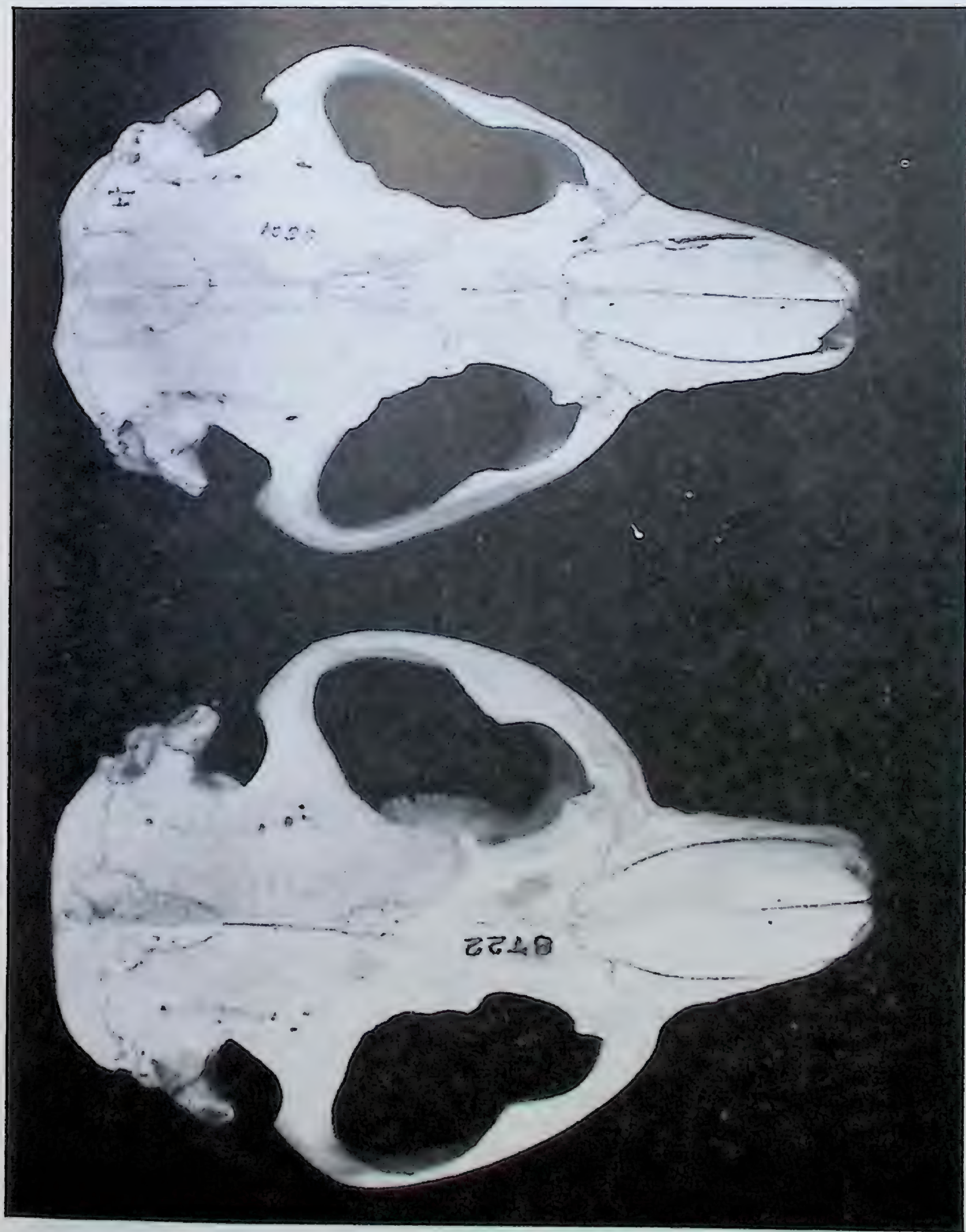


Figure 3. (Left) Skull of eastern beaver (*canadensis*); (Right) Skull of Newfoundland beaver (*caecator*)



The conservation measures have paid dividends. In 1930 the total beaver population on Newfoundland was estimated at about 2,000. In contrast, during the 1949 trapping season nearly 12,000 pelts were sold by the Department of Natural Resources, and the sale netted over a quarter of a million dollars. Nearly 5,000 licences were issued to trappers, and each was authorized to take five animals. In order to ensure the preservation of existing stocks, the season was closed in 1950.

Beaver were observed by the National Museum of Canada field parties in the Codroy Valley, Deer Lake, the east shore of Grand Lake, and at Salmonier. At Salmonier, dams were noted along the courses of many of the smaller streams, and lodges were seen at several points. Because of the scarcity of deciduous trees, black spruce was used for construction purposes. One unused lodge that was opened contained 80 per cent black spruce; the remainder consisted of maple, birch, and alder.

In such cases where deciduous trees are scarce or absent, the beaver feed on the tubers of the yellow pond lily (*Nymphaea advena*). One beaver was observed transporting a large tuber to the lodge, and numerous other rootstocks were observed in the water near the lodge. The floor of one vacated lodge was littered with the sprouting seeds of this plant. Alder is also apparently used as food, but presumably only as a last resort as it is not cut when other deciduous trees are available (Nash, 1951).

In many parts of Newfoundland, the beaver tends to move from one area to another more frequently than on the mainland. The high incidence of vacated lodges in a reserve seems to indicate a frequent shifting to new areas. The scarcity of suitable food trees, such as aspen, along the waterways may be responsible for these movements. According to Warren (1940), about a ton of aspen is required for each beaver in a twelve-month period. Consequently, a large amount is necessary to maintain an adequate supply for a colony that may consist of as many as twelve individuals. Because beavers in Newfoundland may build several lodges within the space of a few years, it is difficult to base population estimates on the number of lodges observed, as is often done elsewhere.

According to Captain Walters, it is not unusual to find beaver living on the barrens far removed from any deciduous woods. Observations made by game officials seem to indicate that the tubers of pond lilies and water lilies constitute the major part of their food. In 1946 a number of these "barren-ground" beaver were transported to a lush aspen woodland where it was hoped they would become established. To the astonishment of game officials, they forsook the forested country almost immediately and returned to the barrens. It would appear that these beaver have become so well adapted to the barren-grounds that they are no longer capable of returning to the forested areas of their progenitors. Life on the barrens would seem to impose a great many hardships that are unknown to forest beaver. They are obliged to use small, stunted black spruces for building purposes, and in many cases they have little control over fluctuations in the water-level of the streams and ponds in which they live. They occasionally do use larger trees which they must transport for long distances through series of intricate canals from some sheltered ravine where a few deciduous trees manage to reach a height of 20 feet or more.



It is interesting to note in this connection that in 1951 when several colonies of beaver were transported from Newfoundland to Kaipokok on the Labrador coast, one colony abandoned the aspen woodlands and immigrated to the coast where they took up residence in a bog lake. According to Game Warden William Anderson of the Labrador Coast, the lake is well vegetated with pond lily, on which the beaver are presumably feeding. Their trek from the woodlands in the interior to the bog lake on the coastal barrens could be readily traced by the trees which they felled en route. Although they passed through numerous apparently ideal habitat on their way to the coast, they presumably paused only long enough to obtain food.

It is now only possible to speculate why a population of barren-ground beaver should have differentiated on Newfoundland. Probably the reason is that when the first beaver colonized the island, the forested areas were very restricted, as even today almost half of the land area is occupied by barrens. If the entire island were barren, the first beavers would be forced to resort to a life in the bog lakes. By the time forested areas had become established and had spread over the island, the beaver had perhaps become so accustomed to bog-lake living, that they no longer were attracted to the forested areas. However, the fact that many, if not most, of the beaver do live in forested areas suggests that some did adapt to the new environment.

That the island may have been barren at the time of the original colonization seems quite probable in view of the fact that the beaver have undergone considerable morphological differentiation during their period of isolation. This would suggest that they have been on the island for a long time, perhaps having colonized it very shortly after the retreat of the ice. The fact is not overlooked, however, that the original colonizers may have been very few in number and that rapid subspeciation may have resulted from inbreeding.

The largest concentration of beaver found by the National Museum of Canada field parties was in the wildlife preserve northeast of the village of Deer Lake. Here they lived in close association with muskrats, and there appeared to be little interspecific strife. According to Leighton (1933) the beavers dislike the muskrats but tolerate them. In this preserve, there are heavy stands of aspen (*Populus* sp.), birch (*Betula* sp.), red maple (*Acer rubrum*), striped maple (*Acer pennsylvanicum*), and mountain maple (*Acer spicatum*). Aspen is by all odds the favourite food of the species and was taken when all other was rejected. The members of the field party placed branches of various deciduous trees on the dam to test their preferences. Aspen was taken in the largest quantities, with yellow and paper birches in lesser quantities. Few red maples were taken, and the alder was not touched.

Because the beaver were in a protected area, they emerged about 5 p.m. and were occasionally seen swimming about in broad daylight. Unfortunately, time did not permit more extensive studies of food habits.

Beaver are rare in the Codroy Valley and at the northern tip of the island in the Port Saunders area. The largest concentrations occur along the courses of the larger rivers, particularly the Humber.



*Specimens.* Humber District: Crooked Feeder (20 miles northeast of the village of Deer Lake), 3.

*Distribution in Region.* See Distribution Map No. 11.

**Newfoundland Meadow Mouse.** *Microtus pennsylvanicus terraenovae* (Bangs)

*Taxonomy.* Bangs (1894) compared a series of over sixty specimens of *Microtus* from Newfoundland with a series of *Arvicola riparius* (*Microtus pennsylvanicus*) from the mainland and separated the former group as a distinct species *Arvicola terraenovae* on the basis of certain colour and cranial characters. He gave as salient cranial characters the following: skull broader than in *A. riparius*, zygoma more flaring, posterior loop of last upper molar trifoliate.

Davis (1936) compared fifty-eight specimens from Codroy, Newfoundland, with specimens of *pennsylvanicus*, *enixus*, and *fontigenus* and concluded that all are conspecific. With the aid of camera lucida drawings he carefully compared the dentition of these races and found no differences. No other cranial differences were apparent as between *terraenovae* and the nominate race. He did, however, find a somewhat greater incidence of a posterior loop on the first upper molar of *terraenovae*.

Of sixteen specimens collected by the 1949 field party, only three or about 19 per cent have the trifoliate posterior loop on the last upper molar, and five of the fifteen have the small posterior loop on the first upper molar. Davis (1936) found this character in 44 per cent of the fifty skulls he examined.

Presumably Bangs accorded the Newfoundland form full specific status on the assumption that insular forms are usually distinct species—a concept in vogue at that time. That such reasoning is unsound has been pointed out by Mayr *et al.* (1953). Other insular populations of *Microtus* were originally described as distinct species but have since been shown to be merely subspecies of a polytypic species. Wheeler (1952) re-examined a series of the Block Island meadow mouse (*Microtus provectus*) and concluded that it is conspecific with *Microtus pennsylvanicus* and may not even be a valid subspecies. She points out that there is no reason to suppose that distinct subspecies of a widely distributed form should necessarily occur on small islands separated from the mainland by only a narrow strait. Many other described allopatric forms await similar studies.

The Newfoundland meadow mouse is the palest of the eastern Canadian forms, and often it has a definite buffy nose patch. The Acadian meadow mouse averages paler than other continental forms from Eastern Canada, but when compared with a series of *terraenovae*, it is less pale with a definite russet cast to the dorsal pelage. Although a resemblance between the Newfoundland form and those occurring in Ungava might be expected, it is surprising to find that all the Ungava forms are dark (Rand, 1943; Davis, 1936). On the other hand, the resemblance existing between the Newfoundland race and that occurring in the Maritime Provinces very strongly suggests a relationship between the two. It seems possible that the Newfoundland population may have been derived from those of Nova Scotia. As has been pointed out elsewhere in this paper, it is very probable that the Appalachian mountain range constituted an effec-



tive barrier to mammalian dispersal in post-glacial times and that the meadow mice of the region west and north of the St. Lawrence River are derived from populations previously lying west of the Appalachian range, while those inhabiting the Maritime Provinces and Newfoundland had their origin in the populations that survived glaciation on the coastal side of this range. Pelage coloration seems to be the most important and most conspicuous character separating the Maritime Provinces - Newfoundland populations from those of Ungava. Laid out in series, the difference between the two groups is striking.

*General.* Although Cormack (1823), Bonnycastle (1842), and Tocque (1878) list the mammals of Newfoundland in their accounts, none of them mentions the meadow mouse as occurring there. Perhaps this is understandable since the species is uncommon on most parts of the island and is not conspicuous even where it is relatively common. Bangs (1913) appears to be the first naturalist to mention the meadow vole, and he states that it was abundant in 1911. Presumably he is referring to the southwestern part of the island where his collector, Ernest Doane, did his trapping.

The 1949 National Museum of Canada field party found these mice very scarce. Trap-lines were established in almost every conceivable habitat, but few specimens were secured and most of these in habitats not generally favoured by the species on the mainland. Thirteen of the sixteen specimens were taken in small overgrown glades in the woods often miles from similar clearings. One specimen was taken on the upper Humber River over 20 miles from any clearings of appreciable size. Local trappers and guides informed the writer that these rodents are generally distributed throughout the wooded areas of the island.

Traps set in and around meadows, open fields, and overgrown pastures were generally non-productive. Local farmers reported that they rarely observed mice, and then only at haying time. At South Brook three specimens were taken along an overgrown fence-row separating a small hayfield and an unused pasture. A trap-line consisting of fifty traps maintained along a hedgerow, separating an orchard and meadow, yielded nothing in a three-week period. The owner informed the writer that he had seen none for several years.

A field party of the Canadian Department of Agriculture collecting small mammals in northeastern Newfoundland in the summer of 1949 also observed a great scarcity. Seventeen specimens were collected in all, most of which were secured in one small area.

Apparently in 1950 meadow mice were rare in the Port Saunders area in northeast Newfoundland. Local residents reported that they were seen occasionally, but the field party did not succeed in securing any specimens. Agriculture is conducted on a very limited scale, and grassy areas are correspondingly restricted. This may account for the apparent scarcity of the species.

In the southern part of the province, at Codroy, however, the writer and his assistant found mice reasonably common. In this section, farming is one of the major industries, and extensive meadows flank the Little and Grand Codroy rivers. Because of the unusual lateness of the season, haying was still in progress in early August, and it was possible to get



first-hand information on the mouse abundance during the haying period. Most of the farmers reported that while mice were fairly common in 1950, they had been very scarce in 1949. Most of them reported that large numbers were seen in the summer of 1948 when they were about ten times as abundant as in 1950. Presumably 1948 was a peak year, and the year following was a low one. Some believed that extensive flooding of the river valleys during the spring of 1950 was responsible for the scarcity of these mammals in 1950. That this had any appreciable effect on the mouse population is questionable, in view of the fact that there was a widespread scarcity throughout Eastern Canada as well as other parts of the island in 1950. A total of twenty-one specimens was taken in this area.

Although the observations of the writer and those of Captain H. W. Walters and D. H. Pimlott of the Newfoundland Department of Natural Resources indicate that the meadow mice never reach a high density on the island, Leslie M. Tuck found a high population on the Coleman and Pickford islands (of the Wadham Island group) in the summer of 1951. Of these he says (in litt.): "The islands appeared to be overrun with these mice, and they could be seen by kicking away loose lumps of turf. Voles and petrels apparently occupied the same burrows. I have no way of knowing whether this is a heavier concentration than usual for these islands. Residents tell me that mice are always found there." He also found a heavy concentration in the Aides Lake area of the Upper Humber and reported that "...in places the ground was honeycombed with their burrows. During the investigations I only observed about a dozen voles, but Mr. Cooper . . . of Aides Lake states that in his twelve years experience in that area, he never before noted so many mice as are present this spring."

The meadow vole has a cyclic fluctuation of roughly four years. Hamilton (1937) found that the years 1919, 1923, 1927, 1931, and 1935 were peak years in central New York State, and Blair (1948) reported a peak year in Michigan in 1946. The latter report suggests that the cycles are of rather wide concurrence throughout the range of the species but that there may be small interruptions of the general cycle, perhaps because of local ecological variations. This is known to be the case with regard to the snowshoe hare (Cameron, 1949). Blair also found that the peak may occur at any time of year. The highest density in Michigan in 1938 occurred in July, while in 1942 the population was at its peak in November. It is interesting in this connection that Chitty (1952) found that in a peak population, the breeding season of British voles (*Microtus agrestis*) ended in August, a month earlier than would be expected, and that in some areas no females bred in the spring of the succeeding year. Thus, it would appear that the population would reach its lowest point, in terms of density, after the adults of the year had died off. If this is usual, the lowest point would be expected in the spring following the "crash."

On the basis of the information available for Newfoundland, it seems quite safe to assume that 1947 or 1948 was a peak year, with a decline in 1949 and a gradual build-up to another peak in 1952. If so, this would be at variance with the cycles observed at various localities on the main-



land. On the other hand, the autumn of 1951 was evidently a peak year in eastern Quebec and Ontario, as mouse damage was particularly evident during the winter of 1951-52.

Because the meadow mouse is the only small rodent native to the island, it presumably played a very important role in the predator-prey relationships before the introduction of the snowshoe hare, Norway rat, and house mouse. The apparent scarcity of ermine on the island may perhaps be due to the scarcity of meadow mice and the small number of alternate forms of prey. As unfortunately the life-history of the ermine, including its food habits, is very imperfectly known, it is impossible to say to what extent it is dependent on mice. It does seem significant, however, that ermine are scarce on both Cape Breton Island and Prince Edward Island where meadow mice are relatively scarce.

As an insular population, the meadow mice of Newfoundland are of particular interest, because they appear not to be restricted to the grasslands where they are most abundant on the mainland. In peak years, mainland voles do invade bogs, swamps, and woodlands, but when the population is low, they are almost completely restricted to the fields and damp meadows. By contrast, as pointed out above, even in 1949 when the population was presumably at a "low," more specimens were trapped in woodlands than in grasslands. It is also significant that woodsmen reported these mice occurring throughout forested areas.

The fact that *Microtus* appears so catholic in its habitat preferences in Newfoundland, and more selective on the mainland, may be due to several factors, of which two immediately suggest themselves: (1) when these mice first colonized the island there were few, if any, grasslands, and they were forced to adapt to a woodland habitat, or (2) the absence of the red-backed mice and deer mice in the woodlands meant that they were free of any interspecific competition. Possibly if red-backed mice were introduced to Newfoundland, the meadow voles would be forced out of the woodlands and would be largely restricted to a grassland habitat. Elsewhere in this paper the question of interspecific competition between the Arctic hare and the snowshoe hare is discussed, and some parallel examples from Britain and the Canary Islands are mentioned. This, of course, brings up the question of why the meadow vole is better adapted to the grasslands and the red-back to the woodlands. It is possible that the competition is indirect and too subtle to detect readily.

*Specimens.* St. Georges District: Codroy, 21; Tompkins, 1; Humber District: South Brook, 20.

*Distribution in Region.* See Distribution Map No. 14.

#### **Newfoundland Muskrat.** *Ondatra zibethicus obscurus* (Bangs)

*Taxonomy.* The Newfoundland muskrat was described by Bangs (1894) as smaller and darker dorsally than *Ondatra zibethicus zibethicus* of the mainland. Other diagnostic characters given by him are as follows: lips and hairs around nose pure white; fringe of hairs on hind feet paler than on toes; underfur darker than in *O. z. zibethicus*; skull smaller and smoother; rostrum larger; auditory bullae relatively smaller; interorbital construction actually broader.



When compared with series of the eastern muskrat (*Ondatra z. zibethicus*), nine specimens of the Newfoundland form (*O. z. obscurus*) show the following average coloration and cranial differences: dorsal guard-hairs a darker brown (almost black), sides and underparts a brighter chestnut; fringe of hairs on the toes paler than foot; interorbital constriction somewhat broader; teeth smaller and weaker. Other differences mentioned by Bangs are less striking in our series; the light area around the snout averages only slightly paler than in the nominate race; and the underfur, if only a little darker than in the eastern muskrat from Lake St. John, Quebec, is considerably more so than in more southern specimens.

The length of the maxillary tooth row is the most reliable character separating the Newfoundland form from *zibethicus* of Eastern Canada. The mean length of the maxillary tooth row (measured along the crowns) for nineteen skulls of *obscurus* was  $13.4 \pm .175$ , while the mean for twenty-three specimens of *O. z. zibethicus* was  $14.8 \pm .152$ . Mayr, Linsley, and Usinger (1953) suggest a method for determining the significance of the variation by obtaining the "coefficient of the difference" as follows: (Symbols: C.D. = coefficient of the difference; Ma = mean of the sampling of *zibethicus*; Mb = mean of the sampling of *obscurus*; S.D.a = standard deviation of the mean of *zibethicus*; S.D.b = standard deviation of the mean of *obscurus*).

$$\begin{aligned} \text{C.D.} &= \frac{\text{Mb} - \text{Ma}}{\text{S.D.a} + \text{S.D.b}} \\ \text{C.D.} &= \frac{14.8 - 13.4}{.152 + .175} \\ \text{C.D.} &= \frac{1.4}{.327} \\ \text{C.D.} &= 4.2 \end{aligned}$$

According to the table provided, a value of 4.2 indicates that there is less than 4 per cent overlap in the two populations (See Figure 4).

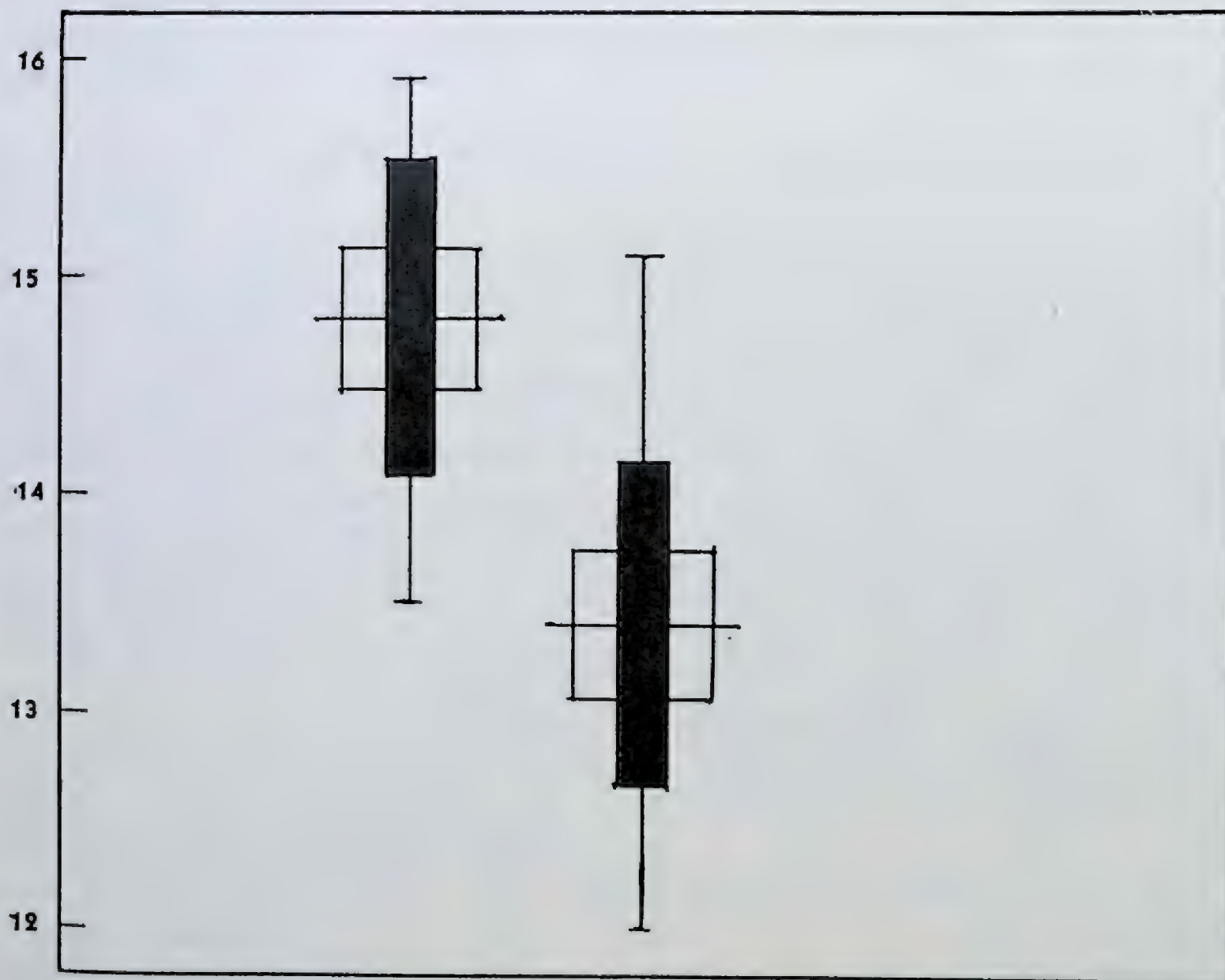
*General.* The muskrat is generally distributed throughout the island but is most abundant in the Avalon Peninsula and in the drainage basins of the larger rivers. A few rats inhabit the rocky lakes and ponds on the interior barrens where they apparently subsist largely on tubers of the yellow pond lily (*Nymphaea advena*), pond weeds (*Potamogeton*), and sedges. The scarcity of food plants apparently necessitates frequent migrations, as many ponds examined showed evidence of previous occupation, although no rats were present at the time. These observations were made in 1949 in a wildlife preserve where trapping operations had not been carried on.

Muskrat trails and cuttings were noted in several ponds on the barrens northeast of Port aux Basques. These bodies of water are largely unvegetated except for yellow pond lily (*Nymphaea advena*) and pond weeds (*Potamogeton*). Wild celery (*Vallisneria* sp.) occurs where there is some water movement. Vegetation surrounding the ponds included: sedges (*Carex* sp.), cotton grass (*Eriophorum* sp.), pitcher plant (*Sarracenia* sp.), alder (*Alnus* sp.) Labrador tea (*Ledum*), and sheep laurel (*Kalmia*).



Muskrats are relatively abundant in the fertile valleys of the Codroy and Humber rivers and frequent the numerous ponds and bays adjacent to the rivers. Bays in the headwaters of the Humber were also frequented by these mammals, particularly near the estuaries of smaller brooks and outlets to swamps and marshes. According to local residents, the muskrat populations in such areas are relatively stable.

The aquatic and littoral vegetation in a well-established beaver pond at South Brook contained the following plants: *Vallisneria americana*, *Potamogeton natans*, *Nymphaea advena*, *Carex intumescens*, *Carex diandra*, *Sparganium* sp., and *Scirpus rubritinctus*. Muskrat cuttings of the following were noted: wild celery (*Vallisneria americana*), pond weed (*Potamogeton natans*), and burweed (*Sparganium* sp.).



Ondatra: Length of Maxillary Tooth Row ( Crowns)  
Figure 4. *Ondatra zibethicus* on left and *obscurus* on right.

Evidence of muskrats was noted in most of the small ponds at Salmonier on the Avalon Peninsula, but of the sixteen examined only one was occupied at the time. Since the area examined lies in a Provincial Preserve, overtrapping cannot be held responsible for this condition. It seems probable that because of the scarcity of food plants the rats are obliged to seek new feeding grounds at rather frequent intervals.



In general, muskrats in Newfoundland rarely attain the population densities observable over most of the mainland. This is undoubtedly due to the almost complete absence of the cattail (*Typha*), which Errington (1948) found to be the staple food of this species. To substantiate this claim he points out that the highest wintering density recorded at Iowa was about thirty-five rats to the acre in cattail marshes as compared with a maxima of fifteen for bulrush (*Scirpus*) marshes. Takos (1947) in his studies on the muskrat in central Maine found that while the food plants most readily available make up the greater part of the rat's diet, cattail ranked first in the list of preferred foods. In Illinois, Bellrose (1950) found that cattail was the most important food of this species. This species also ranks first in the list of preferred foods for muskrats in the Athabasca-Peace River Delta (Fuller, 1951). Cattail was noted at only one point in the Codroy Valley, the only locality where it was observed by the field party. Since it is rare or absent elsewhere, it seems likely that this restricted stand originated from seeds introduced from the mainland. Occasionally cattail is used as packing, and it may have been introduced in this way.

During the period June 28 to July 20, investigations were carried out at Port Saunders in the Strait of Belle Isle Region. There, muskrats were so scarce that in the entire period evidence was noted only once and six traps set in the area yielded only two specimens (male and female). Persistent trapping thereafter produced nothing. Evidently they were the only remaining animals in the more than a score of ponds and marshes investigated. This scarcity was due in part, although by no means entirely, to the lack of suitable habitat. Four ponds examined were almost ideal for muskrats, although of course *Typha* was absent. The extreme scarcity seems to be due, primarily, to over-trapping, as many old traps and sets of various kinds were observed. According to the residents, almost every male in the neighbouring communities trapped this animal. It is one of the few that bring a price high enough to warrant the effort, and since the fishermen are not occupied during the trapping season, the number of trappers per unit area of muskrat habitat is very high.

In the game refuge northeast of Deer Lake, which was visited in the period August 3 to 6 inclusive, muskrats were quite plentiful. A dozen traps were set and baited with the white bases of wild grasses and iris rhizomes. These were placed on floating logs which had been blazed with an axe. Local trappers hold the belief that muskrats are curious about sticks that have been placed along the edges of the stream or lake on the routes they generally travel and that they will stop to investigate every one of them. This belief is at variance with the contentions of other trappers who believe that the surroundings should be altered as little as possible. Whether because of the new sticks on which the traps were set or merely because muskrats were unusually abundant, four rats were collected the first night.

Muskrats were said to be not uncommon near the mouth of the Big Codroy River, although no collecting was done there. Local residents reported that they supplement their incomes from rats trapped in the early spring.



Although the peltries of this species are dark and are of fine quality, they are not favoured by furriers and command a lower price than continental rats. According to J. R. Ewing, furrier at St. John's, the pelts of Newfoundland rats are considered inferior because of the thinness of the skin which makes them difficult to process and work into garments. Extreme thinness of the skin is usually due to malnutrition (Bachrach, 1946), and Dr. Paul Errington of Iowa State College (in litt.) states that the absence of cattail may produce a similar condition.

The muskrat or "musquash" is mentioned by many of the early writers such as Cormack (1823), Bonnycastle (1842), and Tocque (1878). These authors treat at some length the habits of the animals in Newfoundland and describe lodges they examined. The fact that they did find lodges is interesting. Subsequent observers have not been so fortunate.

*Specimens.* Avalon Peninsula: Salmonier, 2; Humber District: Crooked Feeder (northwest of village of Deer Lake), 2; South Brook, 6; St. Barbe District: Port Saunders, 2.

*Distribution in Region.* See Distribution Map No. 15.

#### INTRODUCED:

#### **Norway Rat.** *Rattus norvegicus* (Berkenhout)

*General.* The Norway rat is common in all the settlements on the island, particularly along the sea-coast where fish refuse provides a ready source of food. At low tide, hordes of these rodents may be seen swarming over the exposed rocks feeding on offal. During the winter months when fish wastage is unavailable, the rats move into the dwellings where they constitute a major problem. The only hope of eradicating this destructive and vermin-infested pest is to devise some means of disposing of the refuse.

The rat is also quite widely distributed throughout the interior of the island. A trap set in a forest runway near Salmonier, Avalon Peninsula, on June 21, yielded a female containing nine embryos. Unlike most rats taken in or near settlements, this animal was not parasitized, and the pelage was clean and of fine texture.

The rat, apparently, is very well distributed throughout the wooded parts of the island. According to Mr. C. K. House, Geologist for the Newfoundland Government, rats occur in the most remote areas far removed from human habitation. In the autumn of 1947 House camped for several weeks in the south-central part of the island some 70 miles from the nearest settlement. Almost before he had established camp, the rats moved in and began destroying food supplies. They constituted a major source of annoyance throughout his stay. In the course of his field work, extending over many years, House observed that rats seemed to be abundant in alternate years.

Rats are abundant in the vicinity of lumber camps where they congregate to feed in garbage dumps.



## INTRODUCED:

**House Mouse.** *Mus musculus domesticus* Ratty

*General.* The house mouse is the only small long-tailed mouse occurring in Newfoundland, although it is not impossible that the deer mouse might be found there in the future. Deer mice often enter houses and are occasionally carried among foodstuffs either by boat or rail.

House mice are native to the Old World and were inadvertently introduced on the island. Unlike the Norway rat, they do not appear to have spread throughout the woodlands.

*Specimens.* Humber District: South Brook, 1.

## EXTINCT:

**Newfoundland Wolf.** *Canis lupus beothucus* Allen and Barbour

*Taxonomy.* According to Allen and Barbour (1937), the Newfoundland wolf is a southern relict of the Arctic white wolf. It is a large white animal with rather slender skull proportions and very long nasals when compared with the rather short ascending branches of the premaxillaries. The upper carnassial (pm4) is short in comparison with those of wolves from the mainland, and there is a short diastema separating it from the third premolar so that the two teeth are some 5 mm. apart. Other less striking differences were noted by Allen and Barbour. Although the usual colour of the pelage is said to have been white, there are some records of black animals having been seen.

*General.* The Newfoundland wolf is now extinct, though reports of wolves are received from time to time. It seems likely that these are feral dogs.

No definite information is available as to the exact period when the wolves disappeared, but in 1906 Millais (1907) said that wolves were very rare, and Dugmore (1913) states that a few years later he saw none and that "they are now practically extinct." The wolf is mentioned by Bonnycastle (1842).

Wolves were presumably common in 1839 as an Act designed to encourage the killing of wolves was passed by the Colonial Government on September 14 of that year. Under this Act a bounty of £5 was to be paid to any person submitting a skin for bounty.

There are early records of wolves having been taken at the following localities: Cape La Hune on June 10, 1861, by James Bagg, and on February 18, 1863, by Thomas Dominey; near Fortune on February 27, 1862, by William Harvey Crewe; and at Cape d'Espoir on January 13, 1863, by Joseph Newell. The wolf was the first wild animal concerning which legislation was passed in Newfoundland. Since this bounty was suspended in 1863, it would appear that by that time the wolf population had declined to a point where further control seemed unnecessary (H. W. Walters, pers. comm.).

Until recently the only skin of a Newfoundland wolf known to be extant was one collected near Grand Lake by the Rev. Elwood Worchester in 1896, now in the collection of the Museum of Comparative Zoology. However, in a letter dated January 5, 1952, Leslie M. Tuck, Dominion Wildlife Officer for Newfoundland, reported that he had acquired a pelt



of a wolf shot by the late William Whiteway on the Gaff Topsails about the turn of the century. The skin, tawny in colour, was made into a rug by Mr. Ewing, furrier at St. John's, and is said to be in good condition. It is now in the custody of the Newfoundland Natural History Society at St. John's. Eventually it is hoped that it will be placed in a museum in the province.

The fact that the Newfoundland wolf shows greater affinities to the tundra wolf complex than to the timber wolves of southern Canada strongly suggests that the island was colonized by wolves carried south on the Labrador Current from Ungava or the Arctic Islands in much the same way as the Arctic fox and polar bear are transported southward at the present time. It would seem probable, however, that there were few invasions, since otherwise the resident population would have been swamped by fresh immigrants and subspeciation would have been impossible. The present writer concludes that the Arctic hare and the ermine also were derived from northern Ungava and were transported southward on ice-floes carried by the Labrador Current.

*Specimens.* Humber District: Gaff Topsail, 1 (Mus. Comp. Zool): 3; (United States National Museum), 1.

*Distribution in Region.* See Distribution Map No. 16.

#### **Newfoundland Red Fox.** *Vulpes fulva deletrix* Bangs

*Taxonomy.* The Newfoundland red fox is a small, pale fox said to resemble prairie species more closely than the eastern mainland forms. Bangs (1897) describes the specimen as "pale ocher yellow," with very large hind feet, short tail, and ears rounder than in mainland races.

Bangs described this fox, presumably on geographical grounds alone, as a distinct species. Bailey (1936) in a review of American red foxes, states that "...while several varieties of the North American red fox have been described as distinct species, there seems to be more or less intergradation."

The writer examined the pelt of a mature male in the fur collection of Mr. J. R. Ewing, a St. John's furrier. A pale straw yellow, it was much paler and yellower than specimens of the northeastern red fox (*Vulpes fulva rubricosa*) or the eastern red fox. Another skin examined in the Bangs collection at the Museum of Comparative Zoology was extremely pale, quite unlike any eastern red fox. Despite the pale coloration of these foxes, the pelt was very attractive, and the fur long and luxuriant. Mr. Ewing reported that the pelt examined in his collection is typical of the skins he receives. It would appear, therefore, that the subspecific status of the Newfoundland red fox rests upon its very pale coloration. Patch and silver colour phases, though uncommon, also occur.

*General.* For many years red foxes were uncommon on the island, but from 1944 onward a steady increase was noted. Although common in 1949, 1950, and 1951, they did not appear to be so abundant as foxes were on Cape Breton Island in 1953 or on Prince Edward Island in 1954. Possibly this can be attributed to the scarcity of meadow mice and snowshoe hares during the three years spent by field parties on the island. Since the meadow mouse is the only small rodent on the island (apart from the introduced Norway rats and house mice), it seems probable that



the predator-prey relationship existing between it and the red fox is much more intimate than is the case on the mainland. Hamilton (1935) in his study of the food habits of red foxes in the New England States and in New York State found that mice occurred in 83 of the 206 stomachs examined, and comprised 29.3 per cent of the total bulk. The remains of rabbits occurred fifty-six times and represented 22.1 per cent of the total bulk. Grasses represented 13.9 per cent, and the rest consisted of miscellaneous items, including a few birds. If these results are applicable to Newfoundland, it can be seen that the meadow mouse is a key prey species of the red fox and was undoubtedly more important prior to the introduction of the snowshoe hare than it is today. The Newfoundland hare may have been an important food item before the decline in the population and before it was displaced by the snowshoe hare in the lowlands. Birds probably constitute a relatively small percentage of the total food, as during the winter months they are too scarce to provide a constant source of food. The local residents, however, are of the opinion that during the summer many of the foxes whelp on the upland barrens where they feed on ptarmigan and mice.

In his studies on the food habits of this species in Newfoundland, Dodds (1955) found that remains of snowshoe hares occurred in twenty-eight of the forty-three scats examined, though meadow mice occurred only once. Bird remains occurred in eighteen scats, and beetles in twelve.

As is evident from this, snowshoe hares represent the chief food of the Newfoundland red fox, while meadow mice are of rather minor importance.

*Specimens.* Cormack, 2 (Mus. Comp. Zool.)—St. Georges District: Bay St. George, 3.

*Distribution in Region.* See Distribution Map No. 17.

### **Newfoundland Black Bear.** *Ursus americanus hamiltoni* Cameron

*Taxonomy.* The following original description of this form appeared in the November, 1956, issue of the Journal of Mammalogy (Vol. 37, No. 4):

A New Black Bear from Newfoundland.

Examination of a series of nineteen skulls of the black bear (*Ursus americanus*) from Eastern Canada reveals the existence of a heretofore undescribed race, evidently restricted to the island of Newfoundland. Although the series is small, the characters by which the Newfoundland population can be distinguished from the nominate race are so striking that formal recognition of the island subspecies seems justifiable. This race may be known as—

*Ursus americanus hamiltoni* subsp. nov.

*Type.* Adult male, skin and skull, National Museum of Canada No. 19818, Big Falls, Humber River, Newfoundland; collected July 20, 1949; Collectors: Austin W. Cameron, Sherman Bleakney, Marshall H. Ronalds, Lloyd Duncanson; Collector's No. 27.

*Distribution.* Island of Newfoundland.

*Characters and Comparisons.* The most obvious skull characters distinguishing the Newfoundland race from the nominate race are the greater height of the cranium in the frontal region and the relatively shorter rostrum. The skulls of the nominate race are decidedly flattened dorsally; the curvature from the tip of the nasals to the lambdoidal crest form a gentle curve. By contrast, the greatly inflated frontal





Figure 5. Skull of Newfoundland Black Bear (*Ursus americanus hamiltoni*)



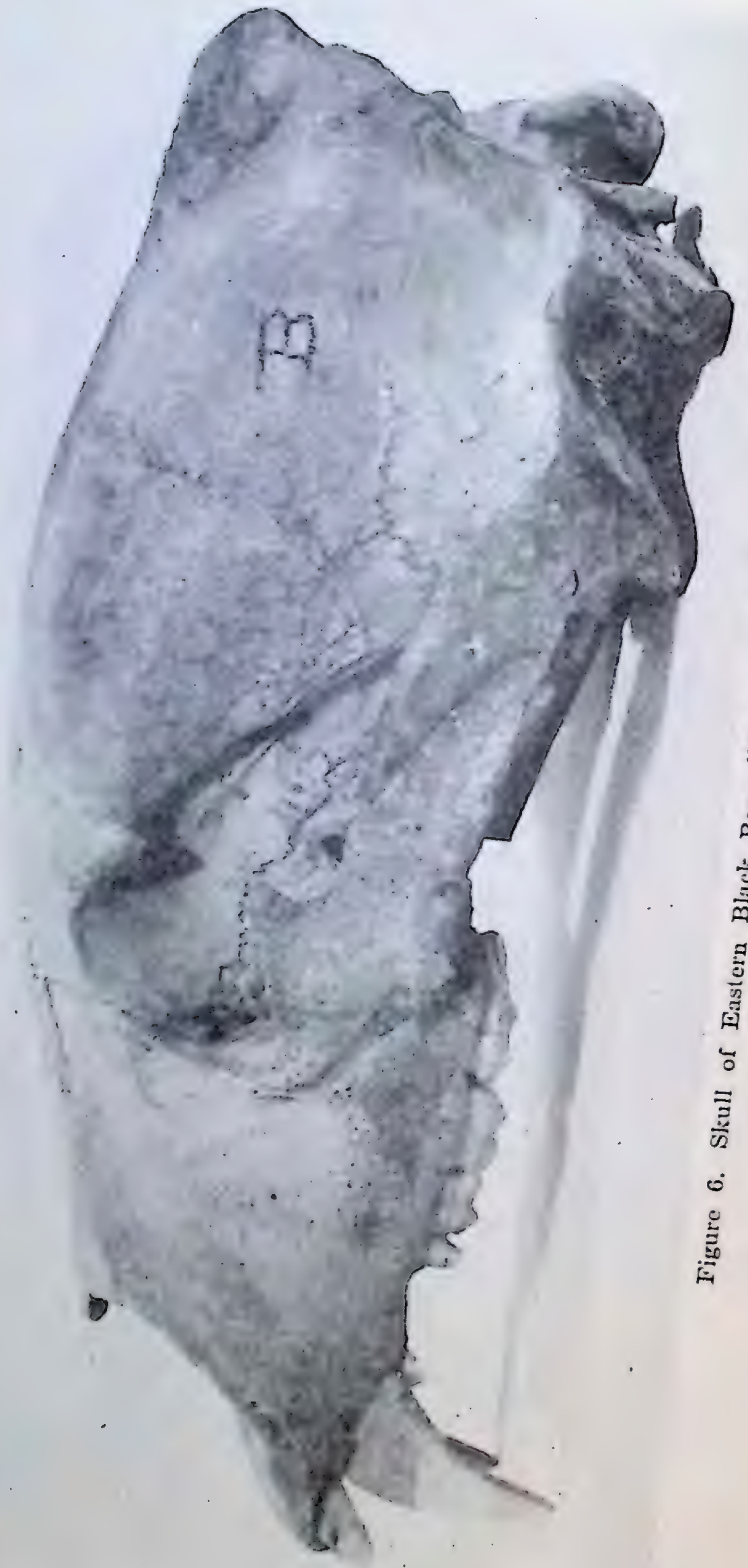


Figure 6. Skull of Eastern Black Bear (*Ursus americanus americanus*)



region of the skull of Newfoundland specimens results in a steep slope both in the naso-frontal and the fronto-parietal regions (Figures 5 and 6). The frontal "hump" becomes more pronounced with age, while the rostrum becomes relatively shorter in relation to the height of the cranium.

In determining the degree of variation present in the two populations, the rostral length was divided into the height of the skull, and the resultant figures treated as whole numbers. In the series of twelve skulls of the nominate race measured, the value ranged from 142 to 179 with a mean of 156, a standard deviation of the mean of  $\pm 11.2$ , a standard error of the mean of  $\pm 3.2$ . The seven Newfoundland skulls ranged from 167 to 187, with a mean of 174, a standard deviation of the mean of  $\pm 6.5$  and a standard error of  $\pm 2.5$ . These are shown graphically in Figure 7. It is evident that the differences are very significant.

The height of the skull was taken from the pterygo-palatine suture at the edge of the palatine notch (anterior to the hamular process of the pterygoid) to the sagittal suture immediately dorsal. The rostral length was measured from the junction of the premaxillaries and the nasals at the edge of the external nares to the inside anterior angle of the zygoma at the posterior opening of the infraorbital foramen (ventral to the lachrymal).

*Measurements of Type.* Skin: total length, 121 cm.; Skull (in mm.): greatest length, 283.3; condylobasal length, 265.3; naso-occipital length, 234.5; premaxilla to occipital condyle, 268.3; premaxilla to palatine notch, 138.8; mastoidal breadth, 90.6; inter-orbital breadth, 61.0; zygomatic breadth, 163.1; alveolar length of maxillary tooth row (including canine), 98.2; alveolar length of mandibular tooth row (including canine), 112.5; height of skull, 100.1; rostral length, 57.5.

*Acknowledgments.* I am particularly grateful to Captain H. W. Walters, C. H. Pimlott, and S. S. Peters, of the Newfoundland Department of Mines and Resources, and to L. M. Tuck of the Canadian Wildlife Service, for their efforts in securing material for the present study.

*Remarks.* Because of the extreme development of the frontal region, skulls of the Newfoundland race can be readily selected from the mixed series including those of the nominate race. Skulls of the two races can be quickly segregated even by a person unfamiliar with taxonomic characters.

The new race is named for Professor William J. Hamilton, Jr., of Cornell University, for his outstanding contribution to North American mammalogy both as a scientist and a teacher.

*Specimens Examined.* NEWFOUNDLAND: Big Falls, Humber River, Grand Falls District: 2; Sheffield Lake, Green Bay District: 1; Gambo Lake, Bonavista District: 2; Deer Lake, Humber District: 1; Meelpaeg Lake, Grand Falls District: 1. ONTARIO: Pine Lake, Rainy River District: 1; Moose Creek, Russell County: 1; Sturgeon Bay, Thunder Bay District: 1. QUEBEC: Sandy Lake, Pontiac County: 3; Val Jalbert, Lake St. John District: 1. ALBERTA: Wood Buffalo Park: 1. "EASTERN CANADA": 1.

*General.* The black bear is common and is widely distributed throughout the island. It is particularly common in the valley of the Humber River where there is an abundance of food in the form of fish, wild fruits, and carrion.

This species is native to the island and is mentioned by the early writers including Cormack (1823), Bonnycastle (1842), and Tocque (1878). Bangs (1913) in his *The Land Mammals of Newfoundland* states that it is "resident and not uncommon."

The National Museum of Canada field parties saw evidence of bears at South Brook and Big Falls on the Upper Humber. At South Brook, the carcass of a cow had been discarded along a wooded road and apparently the bears visited the spot regularly. However, most of the flesh had been cleared from the bones when the field party arrived in the area, and attempts to trap the bears were unsuccessful. However, on the basis of tracks observed, the bears apparently remained in the general area throughout most of the summer.



During the summer months black bears are commonly seen along the Upper Humber, where they congregate to feed on the salmon ascending the river to spawn. Big Falls is an especially favoured spot, because many salmon spend some time in the pools at the base of the falls before succeeding in leaping over them. This gives the bears an excellent opportunity for capturing the fish. In addition, many salmon are dashed to death against the projecting rocks in their attempts to leap the falls. The fish carcasses littered along the river-banks provide an ideal source of food. Despite the abundant supply of food during July and August, the bears are no less prone to break into food stores and unattended cabins. Each year many are killed by fish wardens in an attempt to spare the cabins and catches of the rod fishermen who gather at Big Falls when the salmon are running. During the period July 15 to 20, 1949, four bears were shot within the immediate vicinity of Big Falls. A large male shot by the field party measured 75 inches in total length and weighed approximately 400 pounds. It appeared to be in excellent condition and was probably about six years of age. It was later chosen as the type specimen for the newly described Newfoundland race *hamiltoni*. Apart from this specimen, the field party obtained three skulls and one skin from animals shot in the Big Falls area.

Evidence of bears was also noted near a lumber camp on the Goose Arm Road, 15 miles northwest of Deer Lake. Woodcutters informed the writer that the bears often pilfered their unattended lunch boxes during the day and added insult to injury by destroying the food containers. Only foodstuffs in glass containers escaped their depredations.

Bears are uncommon in the Strait of Belle Isle region of the island and in the Codroy area. The latter has been settled for many years, and much of the land has been cleared for farming. Persistent killing of the bears by sheep raisers has greatly reduced their numbers.

From time to time the Department of Mines and Resources (formerly Department of Natural Resources) has had to implement some form of control in an attempt to reduce the bear damage. In 1945 a special investigation was inaugurated, but no single form of control was found possible.

*Specimens.* See under "Taxonomy."

*Distribution in Region.* See Distribution Map No. 18.

### **Polar Bear.** *Thalarctos maritimus* Phipps

*General.* This species is not resident on the island, but from time to time individuals are carried south on the ice-floes. There are no records to indicate that they have ever spent the summer in Newfoundland. Woodsmen in Labrador report that they have met polar bears in the forested regions travelling in a northward direction.

Bonnycastle (1842) mentions a polar bear killed on April 9, 1842, near St. John's, which excited some interest because they are now "...seldom or never seen in the explored parts of Newfoundland. . . ." Tocque (1878) states that they are occasionally seen along the coast and that "...a few years ago, one of these animals was killed near St. John's." Reeks (1870) believed that it once occurred regularly along the coast but was practically exterminated by sealers and whalers.



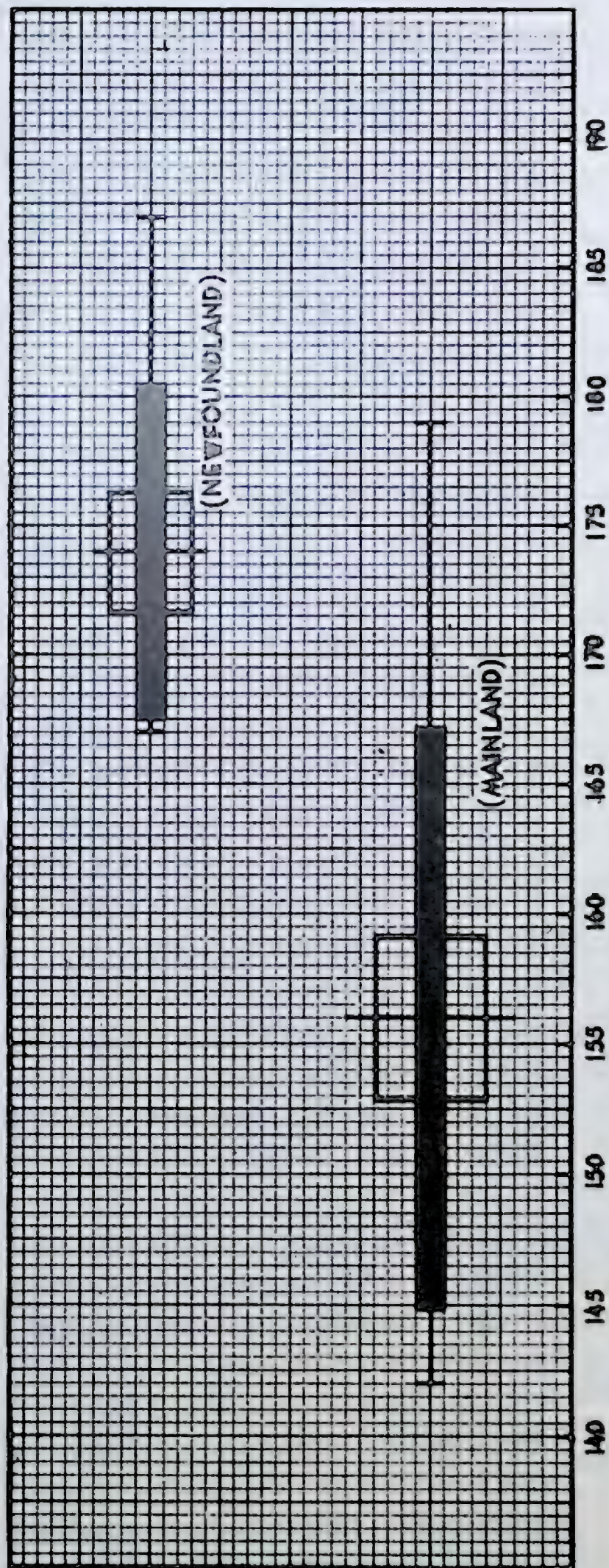


Figure 7. Newfoundland and mainland black bears: standard deviations and standard errors of the mean of the height of the skull divided by the rostral length



Undoubtedly polar bears occur on the coast of Newfoundland more frequently than one might be led to believe from the few authentic published accounts. Lewis and Douth (1942) give specific records for this species on the North Shore of the Gulf of St. Lawrence. Thirteen were reported in the period from 1920 to 1940 inclusive. They also note that bears have been recorded from February to July, with the highest incidence in April and May.

Local residents at Port Saunders informed the writer that a polar bear had been killed at Port-aux-Choix in the spring of 1936. That this appears to be the only record of the species from the northwest coast of the island, would suggest that perhaps these animals are more frequently carried to the northeast coast of the island on ice-floes of the Labrador Current. This is to be expected, because the west coast of Newfoundland is washed by the north-flowing currents from the Gulf of St. Lawrence.

#### **Newfoundland Marten.** *Martes americana atrata* Bangs

*Taxonomy.* The single skin of this form in the Bangs collection at the Museum of Comparative Zoology examined by the writer is much darker than specimens of the nominate race. It can be described as a deep chocolate brown and is, in fact, darker than the lighter coloured wild minks. Bangs (1897) described it as a distinct species, but it was subsequently reduced to a subspecies of *americana* by Rhoads in 1902. Rhoads was of the opinion that it is much closer to the nominate race than to *brumalis*, the form occurring in Labrador. In his study of North American marten, Hagmeier (in litt.) states that, except for its darker coloration, *atrata* is very similar in size and skull measurements to *brumalis*. A study of a larger series, he concludes, may show that *atrata* and *brumalis* are identical. Bangs was of the opinion that *atrata* is smaller than *brumalis* because his series, marked "males," were indeed females, and in this species the females are considerably smaller than the males.

*General.* The marten is now rare in Newfoundland, and the season has been closed for many years. According to Captain H. W. Walters, the largest concentration is now to be found at the south end of Grand Lake. L. M. Tuck reported (in litt.) that a small population occurred in the Gander Lake area in 1950, and D. H. Pimlott reported (in litt.) that marten were seen near Gambo Lake. Local trappers informed the writer that the marten no longer occurs in areas where it was formerly common.

Unfortunately, nothing is known about the food habits of the Newfoundland marten. Before the introduction of the snowshoe hare it must have been largely dependent on the native Arctic hare. Possibly, also, in certain years, meadow mice made up a large percentage of its food. Local residents are of the opinion that it fed largely on birds, but this seems unlikely in view of the scarcity of most species during the winter months. The ptarmigan appears to be the only bird that might be caught in any quantity by this mammal. It is significant that in his study of the food habits of the marten in Montana, Marshall (1946) found that birds were of very minor importance. Red squirrels, red-backed mice, and snowshoe hares were the species most frequently taken. In a similar study in British Columbia, Cowan and MacKay (1950) found that red-backed mice made up 25 per cent of their food and believed that these were hunted selectively since there was no variation in their occurrence in seats



and stomachs despite fluctuations in the mouse population. Altogether, mice made up 66 per cent of the total food of the marten. In connection with the food habits of the Newfoundland marten these results are interesting, in view of the fact that the meadow mouse occurs throughout the forested areas and is abundant in certain areas in peak years.

This species is mentioned as a resident species on the island by Cormack (1823) and Tocque (1878). In 1822 marten were quite common, but as early as 1875 Tocque states that "formerly great numbers of these animals were killed but now they are seldom met with."

*Specimens.* Gander Lake District: Gander Lake, 1.

*Distribution in Region.* See Distribution Map No. 20.

**Richardson's Ermine.** *Mustela erminea richardsonii* Bonaparte

*Taxonomy.* The Newfoundland population was described as a distinct subspecies *mortigena* by Bangs (1913). It was placed in synonymy by Hall (1944).

*General.* The National Museum of Canada field parties failed to obtain specimens of this species. From reports received from game officials and the local residents, it would appear that it is not particularly common on the island, a fact which can perhaps be correlated with the scarcity of mice. In Newfoundland, the absence of most of the small mammals on which the ermine on the mainland feeds, must result in a more intimate prey-predator relationship than exists in areas where small rodents are abundant. Prior to the introduction of the snowshoe hare, house mouse, and Norway rat, the weasel was presumably largely dependent on meadow mice and Arctic hares, apart from the few bird species it might capture. According to Latham (1950), meadow mice make up 34.5 per cent of the food of ermine in the northeastern United States, with rabbits representing 13.1 per cent and deer mice 11.3 per cent. It is therefore quite apparent that the ermine is largely dependent on the meadow mouse, just as the lynx depends on the snowshoe hare. Presumably, when these mice are scarce, the ermine either declines, or must turn to other species. In the sampling from the United States, birds represented only 3.2 per cent of the food that ermine consumed. It may be significant that the ermine is absent from Anticosti, the only island in the Gulf where the meadow mouse does not occur.

This weasel is mentioned by most of the early writers, particularly Cormack (1823), Bonnycastle (1842), Reeks (1870), and Tocque (1878). Reeks states that at the time of writing, ermine were abundant, and Bangs (1913) reports that they "...are very common... and prey upon the vole which occurs in unlimited numbers."

*Specimens* (Mus. Comp. Zool.). St. George's District: Bay St. George and Codroy: 11.

*Distribution in Region.* See Distribution Map No. 21.

**INTRODUCED:**

**Mink.** *Mustela vison* Schreber

*General.* The first mink were imported into Newfoundland by the provincial government on December 6, 1935, but none were distributed to ranchers until 1937. A number of those in captivity escaped and have



become established at various points on the island, even as far north as Port Saunders. In the autumn of 1948, the government released mink on Chapel Island in Notre Dame Bay and on Swale Island in Newman Sound. These were the first planned introductions. However, the descendants of the mink that inadvertently escaped from the ranches have thrived. For example, over a four-year period from 1944 to 1948 the average take was 100 pelts (Leslie W. Tuck, pers. comm.)

It is interesting to note that the wild mink closely resemble the dark animals from Labrador and are so designated by the furriers. Since there is plenty of ideal habitat, it should reach a high density on the island.

Although the mink is not native to the island, it is mentioned as a resident species by Bonnycastle (1842). Obviously he was mistaken in this.

*Distribution in Region.* See Distribution Map No. 22.

### **Newfoundland Otter.** *Lutra canadensis degener* Bangs

*Taxonomy.* The Newfoundland otter is described by Bangs (1898) as small with a short tail and small weak skull with very light zygoma. Bangs gives the characters as follows: "Colour: a deep, lustrous seal brown to black all over except the cheeks, upper lips, underside of neck which are grizzled brown. Underfur greyish-brown at the base and gradually darkening to deep rich brown at the tips. Compared with the skull of *canadensis*, that of *degener* is small and weak with the whole frontal and rostral regions narrow; postorbital processes long and slender; distance from last upper molar tooth to end of pterygoid process short; zygoma short and very slender; auditory bullae small; dentition normal. A young adult male had a total length of 998 mm."

The original describer states that the characters separating *L. degener* from *L. hudsonica* (*canadensis*) are constant and well defined.

The writer examined one pelt in the fur collection of J. R. Ewing, furrier at St. John's, Newfoundland. This specimen was much darker and richer in colour than any specimens of the Canada otter (*Lutra canadensis*) in the National Collection. The dorsum was almost black, shading into a dark seal brown on the throat and along the sides.

Unfortunately, the paucity of material makes it impossible to determine the true taxonomic status of the Newfoundland otter. Judging from the description given by Bangs, however, it seems unlikely that this form is specifically distinct from its mainland relatives. When additional specimens are available for a thorough study of this population, it will probably prove to be a race of *Lutra canadensis*. Pohl (Miller and Kellogg, 1955) treats it as a subspecies of *canadensis*, although he did not have an adequate series for comparison.

*General.* Although generally distributed throughout the wooded parts of the island, the otter is nowhere common. Its valuable pelt has made it the object of persistent trapping, yet the population does not seem to have decreased in proportion to that of other fur-bearers. Probably the inaccessibility of the wilderness streams and lakes that it frequents has been a factor in saving it from the decimation that has befallen so many other native fur-bearers. Also, because of its secretive habits it frequently escapes observation even when living in proximity to man, and it cannot be trapped so easily as many other wild mammals.



No information is available on the food habits of this otter, but the continental forms feed on various species of fish, crayfish, muskrats, birds, beaver, and frogs. In Newfoundland, where many continental freshwater fish are absent, the otter presumably feeds largely on trout with probably the occasional duck or muskrat.

*Specimens.* (Mus. Comp. Zool.). St. George's District: Bay St. George, 4; (National Museum of Canada): Gander River, 1.

*Distribution in Region.* See Distribution Map No. 24.

### **Newfoundland Lynx.** *Lynx canadensis subsolanus* Bangs

*Taxonomy.* Bangs (1897) states in his original description that the Newfoundland lynx is of the size and proportions of the Canada lynx (*Lynx canadensis*) but differs from it in being darker and richer in coloration. This darker coloration was apparent in a pelt examined by the writer in the collection of Mr. J. R. Ewing of St. John's. Bangs describes the coloration of this race as follows: "In summer pelage, underfur on sides is cinnamon rufous throughout, on back black basally and hazel terminally: long hairs (much longer than those of the underfur) of three kinds: (1) wholly black, (2) wholly hazel, and (3) banded with hazel, yellowish grey, and black; predominating colour of whole upper parts black and hazel irregularly varied; face dull yellowish-grey, upper surface of ear black, with a large triangular spot of dark grey, pencil black; legs and arms dull yellowish hazel, faintly spotted with darker; tail very short, dull hazel above, dirty white below, black at tip; belly wood brown with irregular spots of black, the long hairs dirty white."

By contrast, the lynx of the mainland are a uniform ash grey with a faint hazel wash on the upper surface and on the inside of the legs. Furriers prefer the creamy colour of the mainland form with the result that the Newfoundland pelts sell for about 25 per cent less.

On the basis of colour, the lynx of Newfoundland appears to represent a fairly well-defined race, but there is no reason to suppose that it should be accorded full specific status. Elliott (1905) lists it as a subspecies of *canadensis*, though he gives no reason for doing so. However, the difference in colour between the Newfoundland population and that of the neighbouring mainland does not appear to be sufficient reason for according it full specific status.

*General.* The lynx is generally distributed over the island. Local game officials believe that it has increased considerably since the introduction of the snowshoe hare (*Lepus americanus struthopus*) at the close of the last century. Local trappers accredited the phenomenal increase at that time to emigrations from the mainland (Millais, 1907), but the continental and insular forms are separable on the basis of coloration, and none of the former are known to have been taken in Newfoundland and vice versa. Whether the ten-year cycle (Elton and Nicholson, 1942) of the snowshoe hare is now apparent in the Newfoundland lynx has not been determined. It is very probable that this hare is the staple food of the lynx, at least during the winter months.



The absence of small woodland mammals poses the question of what constituted the winter food of the lynx prior to the introduction of the snowshoe hare and other exotics such as the Norway rat. The Arctic hare (*Lepus arcticus bangsii*) was previously more abundant than it is at present and occurred more widely in the wooded and semi-wooded areas, a point which older residents emphasize when discussing this species. The writer found that the meadow mouse occurs in small numbers in wooded areas, and this species may have provided an additional source of food.

*Specimens.* Cormack, 1.

*Distribution in Region.* See Distribution Map No. 25.

#### INTRODUCED:

##### **Eastern Moose** *Alces alces americana* (Clinton)

*General.* Moose were first introduced into Newfoundland in the late 1870's, but they failed to survive. In 1904 several moose captured in New Brunswick were released in the Howley area. The present population is derived from this introduction. Evidently conditions are favourable for this mammal, as it has increased rapidly and spread over almost all parts of the island. That 900,000 pounds of moose meat was provided in 1948 alone is sufficient evidence of their rapid spread.

Millais (1907) was of the opinion that the original introduction would not prove successful, as it took a number of years before any increase in the population was evident. However, by 1935 it was possible to open a season, and progressively larger numbers are taken each year. During the period 1935 to 1943, the number of licences issued was restricted. The first open season without restrictions on the number of licences issued was declared in 1945. The following tabulation gives the licences and kill from 1935 to 1955:

| Year      | No. of Licences | Moose Taken |
|-----------|-----------------|-------------|
| 1935..... | 33              | 8           |
| 1936..... | 65              | 16          |
| 1937..... | 82              | 17          |
| 1938..... | 80              | 29          |
| 1939..... | 100             | 48          |
| 1940..... | 100             | 51          |
| 1941..... | 234             | 95          |
| 1942..... | 220             | 111         |
| 1943..... | 294             | 117         |
| 1944..... | 296             | 145         |
| 1945..... | 2,475           | 747         |
| 1946..... | 3,846           | 1,213       |
| 1947..... | 5,048           | 1,476       |
| 1948..... | 5,158           | 2,078       |
| 1949..... | 5,914           | 2,187       |
| 1950..... | 7,200           | 2,670       |
| 1951..... | 8,669           | 3,404       |
| 1952..... | 6,523           | 2,619       |
| 1953..... | 5,196           | 2,739       |
| 1954..... | 5,754           | 2,383       |
| 1955..... | 6,696           | 3,480       |



The moose has helped to relieve the hunting pressure on the native caribou. Caribou hunting is a rugged undertaking, since they occur on the treeless barrens far from easy means of communication, but moose occur in the wooded areas not far from civilization. In certain areas the two occur in the same habitat. In an aerial survey in south-central Newfoundland, made in 1950, covering 475 square miles, 223 caribou and 196 moose were counted.

Moose were observed by the writer at Goose Arm Road, 25 miles northwest of Deer Lake; Crooked Feeder, 20 miles northeast of Deer Lake; and tracks were seen near the west coast of Grand Lake.

A study of the moose in Newfoundland is now being carried on by the Game Department.

*Distribution in the Region.* See Distribution Map No. 27.

### **Newfoundland Caribou.** *Rangifer caribou terraenovae* Bangs

*Taxonomy.* Caribou occur throughout the arctic and sub-arctic regions of the northern hemisphere, although the Asiatic and European members of the genus are popularly known as "reindeer." The forest-dwelling species of southern Canada are often considered as a group separate from the more northern forms and are generally referred to as the "woodland caribou."

The differences between the two types have to be seen to be appreciated, but in general the woodland form may be described as a larger and darker animal. The size and shape of the antlers have received considerable attention from zoologists as differentiating characters, and when compared directly, the antlers of the barren-ground group appear more round, more slender, and longer in proportion to the small size of the animal, and the tines and the beam, including the brow-line, are but little palmated. By contrast, the antlers of the woodland caribou are flatter, thicker, and more heavily palmated, both on the beams and on the tines, especially the brow antler, whereas the so-called bez-tine is elaborately developed and greatly palmated. Grant (1903) considered the massive development of the bez-tine of the woodland type to be the most distinctive character separating it from the barren-ground type.

The Newfoundland caribou (*Rangifer caribou terraenovae* Bangs) is one of the largest of North American members of the genus *Rangifer*. Taxonomists include it in the woodland (caribou) group, because it exhibits the characters generally associated with that group.

Allen (1896) in his original description (published at about the same time as that of Bangs) gives the following characters of this race as distinctive: size, large; antlers, very massive and much palmated with numerous points; coloration in autumn pelage: upper parts greyish-brown, paler on flanks passing into almost pure white on ventral surface, neck all round a soiled white, nose and face white, circumorbital region white, front and outer surface of legs whitish. Females average darker, and young of the year are still darker.

Dugmore (1913) gives the approximate height of stags, at the shoulder, as between 45 and 50 inches with a total length of from 78 to 84 inches, and weight ranging between 300 and 500 pounds. The doe is somewhat smaller, but there is great variation in both.



Allen (1896) compared a series of Newfoundland caribou with a series of specimens of the eastern woodland caribou (*Rangifer caribou caribou*) from New Brunswick. He found that the mainland form is generally darker than that of Newfoundland with the white of the head restricted to a narrow fringe along the margin of the upper lip. The brown coloration of the back in *R. c. caribou* extends farther down on the ventral surface, and the legs are dark except for a narrow white band around the hoofs.

*General.* The Newfoundland caribou is said to be more migratory than the other woodland species, and a number of excellent accounts have been published concerning their movements. According to Prichard (1910) the population originally consisted of three groups: one in the northern part of the island, which regularly crosses the railway line in the region of Howley and Birchy Lake on its annual migrations; the main herd inhabiting the central and southern parts, and a smaller, apparently non-migratory herd on the Avalon Peninsula. The first group is perhaps best known and is the one whose annual migrations have provided material for the numerous accounts regarding these spectacular movements. Before a refuge was established in the Howley and Birchy Lake regions, where the caribou descend into the lowlands, sportsmen congregated to collect trophies. If we are to judge by early accounts, the extravagant killing by trophy hunters must have seriously reduced the herd (Jacobi, 1931). Although the present population is apparently but a small fraction of the original, they are still numerous enough to hold up trains while crossing the railway.

According to Dugmore (1913) the autumn migration begins about October 20 and continues until about November 5, depending upon the weather. A heavy snowfall seems to be the signal for a start so that in years when there is a prolonged spell of mild autumn weather, the migration may be considerably later than usual. He believed that the herds frequently remained in scattered bands around Sandy Lake during such mild periods. A sudden change of temperature was supposed to result in a frenzied stampede as the animals hastened into the lowlands. Presumably not all of the animals migrate, as a few have been observed in midwinter north of the railway.

This source also states that herds may vary in size from three to four to as high as a hundred or more. He also notes that migrations are made chiefly by day.

Early naturalists, explorers, and sportsmen have made population estimates at various times, and considering the difficulties involved in making a census, it is not surprising to find a considerable discrepancy in their figures. In those days aerial surveys were of course unknown, and estimates were based on sporadic observations made during the annual migrations. Since many of the herds were restricted to the most inaccessible barrens and therefore did not come under observation, the estimates are probably ultra-conservative. On the other hand, observers tend to over-estimate the number of individuals comprising a large aggregation. Perhaps these two factors tend to neutralize one another, and available estimates may not be so far wrong. At any rate, Dugmore, believed that 150,000 was a conservative estimate for the caribou population in 1913.

Early accounts of the Newfoundland caribou state that these animals crossed the Strait of Belle Isle on the ice during the winter. If this were



true, the caribou of Ungava and Newfoundland should represent a single race since presumably there would be nothing to prevent interbreeding and speciation would be impossible. More recent studies have shown not only that such crossings do not occur, but also that the Newfoundland animal is quite distinct from its mainland relative. The Ungava caribou, *Rangifer caboti*, apparently is one of the barren-ground group as the antlers are characteristic of that group.

According to Captain H. W. Walters, Chief Game Warden for Newfoundland, the introduction of the moose has assisted greatly in relieving the hunting pressure on the caribou. Moose hunting in the lowlands is relatively easy compared with stalking the caribou on the remote and tractless barrens, and transportation of the kill presents fewer problems. Nevertheless a number are taken each year.

Caribou hunting is still carried on to a considerable extent in northern Newfoundland, partly because the moose is still relatively uncommon there and partly because hunting them has become almost an institution. Most of the hunters maintain camps at varying distances between the settlements and the hunting grounds. These are usually made ready before the opening of the season, and ample stores are laid away before the actual hunt begins.

In the autumn, usually in late October or sometime in November, a group of the men set out for the mountains with their guns and with as many provisions as they can pack on their backs. They usually plan to be away for about a month.

In the area around Port Saunders, most of the hunters head for the area around Mount Blueie, a peak on the Long Range Mountain which is approximately 2,000 feet in height. Although it is about 20 miles inland and has numerous other lesser hills between it and the sea, it can be clearly seen from the coast.

The position of the herds on the Long Range Mountains, say the older residents, is governed by the wind direction. Since the animals work to the windward, the best hunting on the west side of the mountains is after several days of westerly and southwesterly wind. At this time, of course, the caribou are on their way south, and most of them will eventually reach the mountains on the south coast, crossing the railroad en route.

The residents contend that in the spring, when the weather is getting warmer and the flies have emerged, the caribou are more likely to be found on the shaded side of the mountains where there are still patches of snow. Here they lie amid the drifts and are quite conspicuous against the white background.

Much of the success in hunting these animals depends upon the hunter's luck in locating herds. Once this has been accomplished, there is usually little difficulty in getting an animal, and one may choose the most suitable one in the group. Hunters do not always consider the largest bull to be the most desirable for eating purposes. They consider that the flesh is superior to that of moose, which is often strong, especially in rutting bulls and older animals.



Adult males lose their antlers in December or January, young males and females not until March or April. In their second year, caribou are locally known as "prickets."

Aside from the herds on the Long Range Mountains, where the largest aggregations are to be found, there are large numbers around Gander Lake and in the southern part of the island. There is said to be quite a high density around Victoria Lake in the south-central part.

In the region east of Stephenville and the Codroy valley, caribou are much fewer than formerly, possibly because of extensive hunting, as these areas have been settled for a long time and many of the residents are farmers who are more closely associated with hunting and trapping than are the fishermen of the coasts.

At the present time caribou are generally distributed over most of the unsettled parts of the island, except on the Burin Peninsula where they are very rare. In 1950 in an aerial survey covering 475 square miles in southern Newfoundland, south of the railway, 223 caribou were counted. Despite the relatively large population, the annual kill is rather small. In 1948 a total of 232 were reported killed, while in 1950 the kill was 241. This is partly because most sportsmen hunt moose rather than caribou, as the former occur in more accessible areas.

The number of caribou killed in the period 1935 to 1955 inclusive is given in the following table:

| Year      | No. Taken | Year | No. Taken | Year | No. Taken |
|-----------|-----------|------|-----------|------|-----------|
| 1935..... | 6         | 1942 | 24        | 1949 | 221       |
| 1936..... | 14        | 1943 | 35        | 1950 | 234       |
| 1937..... | 14        | 1944 | 24        | 1951 | 369       |
| 1938..... | 11        | 1945 | 113       | 1952 | 261       |
| 1939..... | 20        | 1946 | 159       | 1953 | 158       |
| 1940..... | 20        | 1947 | 177       | 1954 | 145       |
| 1941..... | 45        | 1948 | 232       | 1955 | 150       |

It is interesting to note that the first act in the colonial legislature regarding the killing of caribou was passed on April 20, 1859. This Act prohibited the killing of caribou (then called "deer") as fox bait, or for any other purpose except as food for human consumption.

*Specimens.* 4

*Distribution in Region.* See Distribution Map No. 28.



## DISCUSSION

### COMPARISON OF THE MAMMALIAN FAUNAS OF THE ISLANDS

In general, islands tend to have a smaller number of mammal species than the nearest continental land mass, a phenomenon evident in the species composition of the mammals occurring on the islands in the Gulf of St. Lawrence. Quite apart from the restricted land area and the small number of ecological niches, a number of factors can be responsible for the paucity of species occurring on islands.

Much depends upon whether there have been land bridges connecting the islands with the mainland and what the nature and duration of these connections were. Since mammals, especially the smaller species, have difficulty crossing a water barrier, it is to be expected that small islands, widely separated from the mainland, would have very few species. Those that have had a brief land connection generally have a small percentage of the mainland species, while islands that have had connections of long duration may have most of the mainland species. Despite the former land connections, islands will, of course, lack those species that were absent from the mainland when the land bridges were present.

The various types of land bridges have been classified by Simpson (1940) as sweepstakes bridges, filter bridges, and corridors. Sweepstakes bridges are not true connections but are groups of islands that serve as stepping stones for the animals in reaching a distant land mass. Filter bridges are connections of brief duration that generally permit only a small proportion of mainland species to reach the islands, while corridors are broad connections of long duration, across which most of the mainland species may pass.

The three northern islands in the Gulf of St. Lawrence, viz., Newfoundland, Anticosti, and the Magdalens, have had no post-glacial land connections as far as can be determined, and their mammalian faunas are derived from animals that succeeded in crossing the water barrier. They, therefore, reached the islands by what Simpson terms a "sweepstakes bridge." On the other hand, there is quite good evidence that Cape Breton Island and Prince Edward Island have had post-glacial land connections, and their mammalian faunas reached them by means of a "filter bridge." None of the islands have had what can properly be termed a "corridor."

Examination of faunal lists for each island reveals to what extent the present mammalian fauna has been affected by the nature of past connections, or lack of them, with the neighbouring mainland. Newfoundland, Anticosti, and the Magdalens have fewer than 50 per cent of the species occurring on their nearest land masses, and in each case at least three families and one order are unrepresented. Furthermore, species that occur on one island may be absent on others. The meadow mouse occurs on Newfoundland and the Magdalens but is absent on Anticosti, while the deer mouse occurs on Anticosti and the Magdalens but is lacking on New-



foundland. The species composition is atypical, with the carnivores well represented, but the insectivores are entirely lacking and the smaller rodents represented by only one or two species. As a result, 80 per cent of the species occurring on Anticosti, 50 per cent on Newfoundland, and probably 25 per cent on the Magdalens are carnivores, exclusive of bats. Because of the paucity of species, some ecological niches are either unfilled or have been appropriated by species which ordinarily do not occupy them on the mainland.

As has been pointed out elsewhere in this paper, the number of mammal species occurring on an island tends to vary inversely with the distance that separates the island from the mainland. It is to be expected that the greater the water barrier the mammals must cross, the fewer the species will succeed in crossing it. Distance, however, is not the only factor; the presence or absence of strong water currents, floating ice or floating debris, and the direction of the prevailing winds are others. The importance of strong, conflicting ocean currents as a barrier to dispersal is evident in the case of Newfoundland, which is only 11 miles from Ungava, but lacks more than 50 per cent of the mammal species found there.

Since, on the basis of the available facts, it is difficult to account for the presence of certain species on the islands and the absence of others, it would appear that dispersal to the three northern islands has been purely random. There are no known factors which can account for the fact that the meadow mouse reached both Newfoundland and the Magdalens but failed to colonize Anticosti, or why the deer mouse should occur on Anticosti and the Magdalens but fail to reach Newfoundland. It is possible that these species did reach the islands, where they are now absent, and have since become extinct, but the fact that they should disappear on an island where conditions appear to be ideal is as much of a puzzle as to assume that they never reached the islands in the first place.

There is, of course, the possibility that the first mammals to reach the islands increased rapidly and appropriated all the available habitats which they found suitable, with the result that later arrivals were unable to become established. For example, the meadow mice may have colonized Newfoundland at a very early date and quickly spread throughout the woodlands, grasslands, and bogs. Later, red-backed and deer mice may have reached the island but were unable to compete with the firmly entrenched *Microtus*. Similarly the deer mice may have prevented the colonization of Anticosti by other small rodents. In order, however, to prevent the establishment of later colonizers, it would seem necessary for the early arrivals to attain a very high density so that, spatially, almost all the available niches were filled when the late colonizers arrived. In view of the rather low densities of the native species on the islands at the present time, it seems unlikely that there could have been greater densities at a time when conditions were less favourable. Furthermore, meadow mice are cyclic, and during a low in their cycle the population density must have been low enough to permit other species to gain a foothold. In our present state of knowledge on the subject of interspecific competition, however, it is extremely difficult to speculate whether early arrivals could effectively block further colonizations of species with similar requirements.

Equally perplexing is the fact that widespread adaptable mainland species do not occur on these islands. Among these might be mentioned



the red squirrel, flying squirrel, red-backed mouse, jumping mouse, and mink. It is amazing that the red and flying squirrels should be absent, considering their abundance and widespread distribution on the mainland, while the smaller deer and meadow mouse should have reached the islands. The absence of the mink, but the presence of the closely related pine marten, is also surprising. One would expect that the semi-aquatic mink would be more likely to reach the islands than the forest-dwelling marten, which very rarely enters water. Possibly those species occurring on the islands were early arrivals to Eastern Canada and therefore had a longer period in which to colonize the islands.

Despite the probable existence of former land connections between Cape Breton Island and Prince Edward Island, respectively, and the adjacent mainland, it is surprising to find that no less than four species are absent. The absence of the raccoon, striped skunk, woodchuck, and porcupine may be because they arrived in Eastern Canada too late to take advantage of the postulated land bridges. That such land connections did exist seems very probable in view of the presence on the islands of such small species as the cinereous shrew, red-backed mouse, and woodland jumping mouse. In fact, the mammalian faunas of these islands are almost identical with those of the neighbouring mainland.

In the course of field studies, it was found that in addition to the paucity of species, mammals appear to be less abundant on the islands than on the mainland. It was surprising to find deer mice scarce on Prince Edward Island and Cape Breton Island, and this scarcity of the smaller prey species appeared to be reflected in the scarcity of predators such as ermine and buteo hawks. It is difficult to account for this scarcity since there appears to be plenty of suitable habitat.

### GEOLOGICAL HISTORY OF THE REGION

The erratic distribution of mammals on the islands in the Gulf of St. Lawrence can probably be attributed to the geological history of the region, since the present distribution cannot be attributed to present conditions. If the geography of the region when mammals first invaded Eastern Canada was essentially the same as it is now, the islands would have most of the larger mammals occurring on the adjacent mainland but would lack many of the smaller species. In actual fact, however, the reverse is true with regard to Prince Edward Island and Cape Breton Island. It is therefore clear that conditions must have been quite different in this region when the mammals first arrived in Eastern Canada.

Since Prince Edward Island and Newfoundland are separated from the mainland by straits of about equal width, it would be natural to suppose, if the ocean currents are disregarded, that each would have about the same proportion of the mammals occurring on the adjacent mainland. But this is far from being the case. Prince Edward Island has all of the mainland species except several fairly large species, while in Newfoundland almost all the smaller mainland species are lacking. Cape Breton Island, like Prince Edward Island, has almost all of the smaller species but lacks certain larger species. Anticosti and the Magdalens are both depauperate in species. This is probably to be expected since both are



rather widely separated from the mainland. In short, the mammalian faunas of Newfoundland, Anticosti, and the Magdalens are essentially as one would expect under present conditions, but those of Prince Edward Island and Cape Breton Island are not.

A consideration of the geological history of the region, however, throws considerable light on this rather anomalous situation. All available evidence indicates that the three northern islands (Newfoundland, Anticosti, and the Magdalens) have been separated from the mainland since the retreat of the Wisconsin ice-sheet and therefore were islands at the time when mammals first invaded Eastern Canada (Twenhofel, 1912; Coleman, 1941). On the other hand, the evidence seems to indicate that Prince Edward Island and Cape Breton Island have had rather recent land connections which would account for the presence of the smaller species that would have difficulty colonizing an island separated from the mainland by a strait a mile or more in width. These facts of course do not entirely explain the situation, since it is necessary to account for the absence of the woodchuck, raccoon, striped skunk, and porcupine on Cape Breton Island and Prince Edward Island, and they fail to explain why only certain of the smaller species reached the three northern islands and why the same species do not occur on all three. This matter will be discussed elsewhere.

It is important to point out here that any consideration of the present distribution of the mammals in Eastern Canada is concerned only with conditions that have existed since the retreat of the last or Wisconsin ice-sheet. In all probability, mammals occurred in the region before the area was glaciated and possibly during the inter-glacial periods. But there is very little doubt that most of the region was completely ice-covered during the last glacial advance, and even if unglaciated areas were present, it is very doubtful if mammals could have survived in them (Deevey, 1949). Therefore, the only invasion of the region of interest here is the one which occurred since the retreat of the last ice-sheet.

It was thought at one time that many areas were unglaciated and that certain plant species survived glaciation in these refugia. Because no evidence of glacial abrasion or scouring could be found on the tops of the Shickshock Mountains on the Gaspé Peninsula, the higher hills of northern New Brunswick, or the Long Range Mountains of Newfoundland, it was assumed that they were unglaciated. However, in his study of the geology of the Shickshock Mountains, Alcock (1935) found ample evidence of glaciation, despite the absence of striae. Boulders of rocks found only in Ungava were found on the tops of the Shickshocks, obviously carried there by the glacier. The absence of the characteristic striae resulting from ice abrasion, he concluded, can be explained by assuming that as the climate cooled, small local glaciers formed on the tops of the mountains and the advancing Laurentide Sheet rode over these local glaciers. The smaller, static glaciers, of course, shielded the underlying rocks from abrasion, thus accounting for the lack of striae.

The theory that nunataks were present throughout glaciation was based, in large measure, on the botanical studies of Fernald (1925), who found plants on the Gaspé and in Newfoundland which he declared were relict species that must have survived glaciation in refugia. More recent



studies by Wynne-Edwards (1937) and Scoggan (1950), however, have shown that the plants Fernald believed to be relicts are in fact species that occur in these regions because of favourable climatic and edaphic conditions. Thus, it is unnecessary to postulate the existence of unglaciated areas to account for their presence at the present time.

According to Dr. V. K. Prest, geologist with the Canadian Department of Mines and Technical Surveys, who has studied the pleistocene geology of the region, the only area that might have escaped glaciation is the Magdalen Islands Archipelago. To date, no conclusive evidence of glaciation has been found there. He postulates that perhaps an arm of the sea extended westward through Cabot Strait and surrounded the islands. But it is unthinkable that any mammal could have survived there throughout the glacial period, even assuming that the land area was considerably greater than it is at present.

Briefly, all evidence points to almost total glaciation throughout the region in question with no ice-free areas of sufficient size to harbour mammals during the glacial period. It follows, therefore, that the present mammalian fauna must have been derived from species that survived in more southern regions beyond the glaciated area.

It seems probable that the species now occurring in the region spent the glacial period in what is now the southern United States. It is also probable that the Appalachian Mountain Range had local montane glaciers and was uninhabitable throughout most of its length. If this is true, then it is also possible that it constituted a formidable barrier to dispersal and that little interchange took place between the populations on either side of the mountain chain. The St. Lawrence River and the Great Lakes system also constituted a barrier, particularly for the smaller species.

In any consideration of the colonization of Eastern Canada, this is an important matter since it is probable that the Maritime Provinces were colonized by mammals that spent the glacial period on the coastal side of the mountains while those species that moved into what is now Ontario, northern Quebec, and Ungava may have spent the period west of the range. This would account for the fact that differentiation in the populations in the Maritime Provinces and in Ungava followed different evolutionary lines. The fact that the two populations do show certain morphological differences is of assistance in determining the probable origin of the populations now occurring on the islands.

To recapitulate, the islands of Newfoundland, Anticosti, and the Magdalens differ in the composition of their mammalian faunas from Prince Edward Island and Cape Breton Island, because they have been separated from the adjacent mainland since the retreat of the ice and were islands at the time when mammals first invaded the region, while the latter two islands probably have had post-glacial land connections. Although there may have been small, unglaciated areas in the region, probably none of them was large enough to enable mammals to survive throughout the glacial period. Supposed evidence for the existence of refugia has since been shown to have been based on erroneous assumptions. It is suggested that the mammals of Ungava and those of the Maritimes are derived from stocks that spent the glacial period in areas separated from one another by a barrier formed by the Appalachian Mountains.



## EVIDENCE OF POST-GLACIAL LAND CONNECTIONS

In view of the fact that the mammalian faunas of Cape Breton Island and Prince Edward Island are essentially like those of the neighbouring mainland, it seems most likely that land bridges must have connected the islands and mainland in post-glacial times. Neither island has any known endemic races, and, in fact, the populations occurring on them exhibit remarkably little variation compared with those of peninsular Nova Scotia. On the other hand, the peninsula has no less than five endemic races not known to occur elsewhere on the mainland. It would appear, therefore, that the isthmus of Chignecto is a more effective barrier to mammalian dispersal than the straits separating the islands from the mainland. Although variations in pelage colour and cranial characters are apparent in some island populations, they are not sufficiently well marked to warrant the recognition of separate races. By contrast, the British Isles, which are definitely known to have been connected to the mainland of Europe little more than 7,000 years ago, have several endemic races including the well-marked British squirrel (Matthews, 1952). This would strongly indicate not only that the two islands in the Gulf of St. Lawrence were connected by a land bridge in post-glacial times, but that the connection must have been relatively recent. Otherwise it is necessary to postulate the existence of factors conducive to subspeciation in Britain that are absent in Eastern Canada. There is, however, no evidence that such factors do indeed exist.

Since the mammalian faunas of the two southern islands in the Gulf of St. Lawrence have essentially the same composition as those of the continent, they are said to be "harmonic" as compared to the three northern islands where several families are absent and others are poorly represented. In those cases where the fauna composition is "unbalanced" as compared with the faunas of the nearest land mass, the fauna is said to be "disharmonic" (Lack, 1947). Disharmonic faunas are generally found on those islands which have been colonized by animals that were obliged to cross a water barrier, as opposed to those that had the advantage of a land bridge.

The fact that almost all the mainland species also occur on the islands appears to be further supporting evidence. Disregarding the absence of the raccoon, striped skunk, woodchuck, and porcupine, which are probably recent arrivals to southern Canada, the mainland and island faunas are identical. The presence of all of the small rodents and most of the shrews is significant since these are the species most frequently absent or poorly represented on islands that have been cut off from the mainland for some time (Matthews, 1952; Carter *et al.*, 1945; Tate, 1952). Even Ireland, which is known to have had a post-glacial land connection, has only one species of shrew compared with the three species occurring over most of England. The contrast between the number of small rodents occurring in England as opposed to Ireland is even more striking. Of the six species of mice occurring in England, only one is native to Ireland. If islands that are definitely known to have had land connections lack such a large percentage of the smaller mammals present on the nearest land mass, how much more unlikely that islands without any land connection should have all the smaller species of the neighbouring mainland! Although the North Channel separating Ireland



and Scotland is 20 miles in width and Northumberland Strait is only half as wide, it is highly improbable that the paucity of species on the former can be attributed to the relatively small difference in the distances involved.

The view that there has been a land connection in post-glacial times seems to be further supported by the presence of at least no less than four species of salamanders and five species of frogs on both islands. The possibility that they have reached the island on floating debris cannot be overruled, but their chances of having done so in the short period since the retreat of the ice is rather slight. The occurrence of amphibians on some of the tropical islands, such as the East Indies (Wallace, 1911), can be partly explained by the long period available for colonization. Probably of the thousands of salamanders that have been carried to sea on floating logs, only very few have managed to survive long enough to colonize a distant island. Since so many repeated attempts are necessary, it follows that colonization is likely to take place only after many years have elapsed. The chances of such colonization within the space of a few hundred years, however, is very small indeed. It is also significant that amphibians and reptiles are absent from Newfoundland, Anticosti, and the Magdalens, which are believed not to have had post-glacial land connections, despite the fact that toads (*Bufo terrestris*) and wood frogs (*Rana sylvatica*) occur at least 200 miles north of the Strait of Belle Isle area (Bleakney, 1954). Ireland, despite its former land connection, has only one species of salamander (*Triturus vulgaris*) and one lizard (*Lacerta vivipara*) as opposed to twelve species of reptiles and amphibians native to England and Scotland (Smith, 1952). Of the thirteen species of Amphibia known to occur in peninsular Nova Scotia, eleven occur on Cape Breton and Prince Edward Island, and probably further collecting will reveal the presence of others (Bleakney, unpub.). The absence of turtles on both islands seems to be due to their late arrival in the region after the land connections had disappeared since they are more southern in distribution than snakes, which occur on the islands.

The presence on Cape Breton Island of no less than six of the twelve truly freshwater fishes occurring on the peninsula of Nova Scotia very strongly suggests a post-glacial connection, since it is difficult to imagine their crossing the salt-water barrier. There is a slight possibility that they were introduced by salmon or trout fishermen, but it seems rather improbable. The following is a list of the freshwater fishes of Cape Breton Island as compiled by Livingstone (1953):

- Common White Sucker (*Catostomus commersonii*)
- Northern Creek Chub (*Semotilus a. atromaculatus*)
- Northern Pearl Dace (*Margaricus margarita nachtriebi*)
- Northern Redbelly Dace (*Chrosomus eos*)
- Eastern Golden Shiner (*Notomigonus c. crysoleucus*)
- Eastern Banded Killifish (*Fundulus d. diaphanus*)

By contrast the only fishes inhabiting the streams and lakes of Newfoundland, Anticosti, and the Magdalens are anadromous.

The distribution of freshwater leeches on Prince Edward Island seems to lend further support to the view that the island has had a post-glacial



land connection with the mainland. Three of the eight species occurring there are non-sanguivorous and secretive and could not have been carried there by birds, according to Richardson (1943). In addition to these three species, viz., *Haemopsis grandis*, *Nephelopsis obscura*, and *Dina farvida*, he considers it unlikely that another species, *Haemopsis marmoratis*, could have been transported by birds as it will not remain on a host after the latter has left the water.

Because of the above, it is difficult to avoid the view that both Cape Breton Island and Prince Edward Island have had post-glacial land connections. Although each piece of evidence cited above is open to some question, taken together the over-all evidence is very convincing. The contrary view that there has been no post-glacial land connection is difficult to accept, considering the richness of the islands' mammalian faunas and the absence of endemic races. If these islands do, indeed, belong in the same category as those that have had no recent post-glacial land connections, they are most atypical.

Geological evidence of land connections between the islands and the mainland is inconclusive, and geologists are divided in their opinion whether the region has undergone emergence or subsidence since the retreat of the last ice-sheet. The presence of raised beaches along the lower St. Lawrence River has led one school to conclude that there has been a general uplift in the region or a lowering of the sea-level. Goldthwait (1924) states that "At the close of the last Glacial epoch, the land was more submerged than it is now. The evidence of this is clear along the coast of Maine and New Brunswick, up the St. Lawrence Valley, and around Lake Champlain, where sands and clays containing marine fossils lie on top of the glacial drift, and distinct gravel beaches are found in places now from 100 to 600 feet above the sea. Apparently there has been an uplift of the region since the retreat of the ice; but as presently will be seen, it is possible that perhaps this change, as registered in the Maritime Provinces, consisted in part of a movement of the sea instead of a movement of the land. Following this change of level, by which the beaches came to occupy a position several hundred feet above the sea, there was a submergence of the coast in the same region to an extent of at least 35 feet. This is registered by drowned forests around the head of the Bay of Fundy" (p. 148). He states further (p. 173) that "...the Acadian shore-line, like that of the eastern United States, has enjoyed a period of approximate stability for several thousand years and that the supposed evidence of modern subsidence is deceptive, being due to a variety of causes unrelated to any progressive change of level, prominent among which are local variations in the level of the high tide surface due to variations in the form of the shore-line."

It has been argued that the land subsided during periods of glaciation because of the weight of the ice and that with its removal there was a general emergence. At the same time there was undoubtedly a rise in the sea-level as a result of the melting of the glacier. Possibly both emergence and rise in sea-level occurred in post-glacial times, but the evidence of either submergence or subsidence would depend upon whether the final result was that of greater or lesser land surface being exposed. If there has indeed been emergence, or lowering of the sea-level since the retreat of



the ice-sheet, then there could have been no land connections between the islands and mainland, and the land area of Prince Edward Island must have been much smaller than it is today.

The alternative theory that there has been submergence in the region is put forth by Johnson (1925), who has amassed a tremendous volume of convincing evidence. He concludes that there has been a general warping or tilting, involving a submergence which is progressively greater as one moves northeast from the area around New York City. A striking piece of evidence for submergence is the presence of drowned forests at Fort Lawrence (on the Bay of Fundy side of the Isthmus of Chignecto). He states that "At Fort Lawrence as throughout the whole region, forests of spruce, hemlock, birch, alder, ash, elm, and other trees, covering the ridges and valleys of maturely dissected and glaciated Carboniferous lowland, were gradually killed and buried during post-glacial time by the encroaching silt of the Fundy marshes as the sands sank or the sea-level rose." Submerged forests have been located as deep as 30 feet below marsh level, and borings in the Aulac area have indicated buried stumps at a depth of 180 feet. Submerged stumps have also been located at Baie Verte on the Gulf side of the Isthmus of Chignecto, and at St. Simeon's Inlet, Shippigan Harbour, northeastern New Brunswick.

He finally states that "...The tidal marshes seem to indicate submergence as the last important movement along the New England coast. Had there been a recent emergence, it should be recorded by uplifted salt marsh deposits, by a general encroachment of the fresh marsh upon salt marsh, and by other phenomena which seem to be absent from the coast."

In general, the evidence as given by Johnson appears more convincing, though possibly there has been both emergence and subsidence at different periods since the retreat of the ice. The fact that submergence occurred at a time when the land was well forested may indicate, as Johnson states, that subsidence has been the last important change in land level. There may also, of course, have been changes in the sea-level, as undoubtedly there was with the release of great quantities of water from the melting glaciers. Either a sinking of the land or a rise in the sea-level since the retreat of the ice would have made land connections possible within the last ten thousand years. If, at the present time, the sea-level were to be lowered as little as 48 feet, Prince Edward Island would be connected by a land bridge with New Brunswick. A further lowering of 36 feet would connect Cape Breton with peninsular Nova Scotia, and in all probability the present depth of the water in the Strait of Canso is due to submarine erosion caused by the strong currents sweeping through the narrow gut.

To recapitulate, Cape Breton Island and Prince Edward Island are believed to have had post-glacial land connections with the mainland, because (1) over 80 per cent of the mammals occurring on the mainland of Nova Scotia also occur on the islands; (2) subspecifically the mammals on the islands are identical with those on the neighbouring mainland—there are no peculiar insular races; (3) all the mainland shrew species and all the smaller rodents, which are either poorly represented or absent on islands which had had no land connections, are present on these islands; (4) the number of amphibian species is only slightly less on the



islands than it is on the mainland, and future collecting may reveal the presence of some of those not now recorded; (5) of the twelve freshwater fishes recorded for peninsular Nova Scotia six occur on Cape Breton Island; (6) the presence of drowned forests in the Northumberland Strait region strongly suggests a relatively recent post-glacial land subsidence; (7) it would be necessary for the land to rise only 85 feet to connect both islands to the mainland; and (8) these islands show many faunistic similarities to the British Isles which are known to have been connected with the European continent only 7,000 years ago.

#### COLONIZATION OF CAPE BRETON AND PRINCE EDWARD ISLAND

The absence of many mainland species on the three northern islands in the Gulf is to be expected in view of their geological history. But the absence on Cape Breton Island and Prince Edward Island of species which are common and widely distributed on the nearby mainland is less readily explained. As pointed out previously, there is fairly good evidence that both islands had a land connection with the mainland in post-glacial times, and it would seem reasonable to suppose that the mammalian faunas of the islands and mainland would be identical. Yet, no less than four mainland species are definitely absent on the islands: the striped skunk, raccoon, woodchuck, and porcupine. Since they are large, hardy, and adaptable species, it would seem probable that they would have reached the islands perhaps even in the absence of a land connection. In view of the absence of these large species, it is surprising that all of the smaller rodents and shrews should occur.

The absence of these four species can probably be best explained by assuming that they were invaders which arrived too late to take advantage of the land bridge. Fortunately, there is some evidence to support such an assumption.

With regard to the raccoon in Nova Scotia, Gilpin (1870) states that it "... has but lately appeared among us, and in the Annapolis Valley has yet only penetrated the North Mountain—being unknown on the south side of the valley." He further states that it appeared first in the Cobequid hills area, which is less than 50 miles from the Isthmus of Chignecto. The Micmac Indians at that time, he points out, were unfamiliar with the animal. After it moved into the province, it increased rapidly and spread over the greater part of the peninsula.

This information as it stands would seem to leave no doubt that the raccoon is a very recent immigrant to peninsular Nova Scotia and that its absence on Cape Breton Island and Prince Edward Island is quite understandable since the postulated land connection between the islands and mainland had disappeared before the region was invaded. The picture, however, is complicated by the fact that the raccoon apparently occurred in the peninsula around 1600, when the first white explorers arrived. The presence of skeletal remains of this mammal in Indian shell heaps that predate European explorations is further evidence.

Rand (1943a) states that Lescarbot, who visited Nova Scotia in 1606, speaks of an animal known as "nibaches" by the Indians, which was described as having paws like an ape, a head like a fox, a grey coat, and being incredibly fat. This description could scarcely apply to any other



animal, even by a wild stretch of the imagination. It is interesting that by 1868 the Indians had forgotten this mammal, including the name applied to it by their ancestors three hundred years earlier.

The archæological evidence includes five complete lower jaws and four canine teeth found in shell heaps in Pictou County (Quarry Island; Merigonish; Olding Island) and now in the National Museum of Canada archæological collection. Numerous raccoon bones were also found in shell heaps at Mahone Bay, Lunenburg County, along with those of lynx, caribou, woodchuck, and hare. None of the artifacts present in the shell heaps show any evidence of European influence; it is therefore inferred that the heaps were formed before the white man arrived.

Considering both the historical and archæological evidence, it appears that raccoons were common and widespread in peninsular Nova Scotia until about 1600 or somewhat later, and then, for some unknown reason, they disappeared. Then, about 1860, they reinvaded the peninsula from New Brunswick and first became established in the Cobequid Hill region, spreading subsequently to central Nova Scotia. Accounts published at this time do not mention raccoons as occurring east of the Bay of Fundy region, suggesting that the dispersal eastward was relatively slow. Even today, the population at the eastern end of the peninsula is rather low compared with the central part of the province. Since the raccoon does not now occur on Cape Breton and Prince Edward Island, it must be assumed that either (1) it formerly inhabited the islands but disappeared there just as it did on the mainland, or (2) the first invasion into the peninsula was relatively recent and therefore too late to take advantage of the land bridges.

As it is only within the last century or so that the raccoon has reached northern New Brunswick, it seems likely that it is a rather recent arrival in the region. Possibly its disappearance on the peninsula of Nova Scotia can be attributed to its failure to adapt to a new environment, to which, in the last invasion, it finally became adjusted.

Although there is no definite evidence, it seems likely that the striped skunk, woodchuck, and porcupine were also recent invaders, arriving after the region had subsided and the land bridges were consequently no longer present. This is quite understandable in the case of the skunk, which even today is uncommon in the Gaspé Peninsula and does not go much farther north of the Saguenay River on the North Shore of the Gulf of St. Lawrence. The theory does not seem quite so applicable to the other two species: the woodchuck occurs north at least to Makkovik in Ungava, and the porcupine ranges north to the limit of trees. However, factors which are not now apparent may have then been operative.

The northward spread of mammals following the retreat of the ice probably did not consist of a single advance. It is more probable that with fluctuations in the climate the vanguard was halted or reversed at various times. There is considerable evidence that there has been alternate warming and cooling of the Atlantic Coast even within the last sixty years (Dunbar, 1955; Thomas, 1955). Thus it is possible that as the result of a climatic cooling, the raccoons disappeared from Nova Scotia around 1600, and the reinvasion around 1865 was made possible because of an amelioration of the climate.



## PROBABLE ORIGIN OF THE INSULAR MAMMALS

In general, the fauna of an island is derived, directly or indirectly, from the nearest continental land mass. In the Gulf of St. Lawrence region, it would be natural to suppose that Newfoundland received its mammals from Ungava, Anticosti from the Quebec North Shore, and the Magdalens from either Cape Breton Island or Prince Edward Island. However, on comparing the insular mammals from the point of view of morphological similarities and differences, it seems probable that in some cases these islands were populated by animals originating in areas other than the nearest land mass. Perhaps this can be expected, considering the past history of the region and the nature of the ocean currents in the Gulf.

Although Newfoundland is separated from Ungava by a strait only 11 miles in width, it has less than 50 per cent of the species occurring in Ungava, and there is evidence, though scanty, that some of those now present on Newfoundland reached the island from areas farther south. The strong, conflicting ocean currents in the Strait of Belle Isle evidently constitute a very effective barrier to mammals, considering the few that have succeeded in colonizing the island. The strength of the currents prevents the formation of a permanent ice bridge; it appears, indeed, that solid ice occupies the strait only in cases of an ice jam. Therefore, mammals have not had an ice bridge at their disposal.

It is extremely difficult, of course, to obtain definite information on the areas from which the insular mammals originally came or the routes of ingress they might have taken. In certain cases, such information can be inferred by comparing the morphological similarity of the insular races with those on the mainland and assuming that where an island race and a mainland race show certain similarities, they are more closely related than either is to other races which differ to a greater degree. It has been possible in a few cases to make such a comparison among the races occurring on the Gulf of St. Lawrence islands and the neighbouring mainland.

Fortunately, in the case of a number of species, the races occurring in Ungava and those found in the Maritime Provinces and on the Gaspé Peninsula differ in a number of respects, and it is thus possible to determine to which group the insular races appear to belong. As mentioned elsewhere in this paper, it is probable that during the height of Wisconsin glaciation, the mammals now found in Eastern Canada were located in the southeastern United States. It is also probable that the Appalachian Mountain Range, with its local montane glaciers, and the St. Lawrence River represented barriers that may have kept the populations east and west of them effectively isolated. Thus differentiation was possible. With the retreat of the ice, these populations moved northward; those on the eastern coastal area moved north and eventually colonized the Maritime Provinces, while those on the west probably moved north to what is now Ontario and Quebec (west of the St. Lawrence River), eventually reaching Ungava. If this is true, then the races in the Maritimes and those in Ungava would be expected to differ.

The meadow mouse (*Microtus pennsylvanicus*) provides a good example of differentiation in eastern North America. Five, and possibly six, races are recognized in Eastern Canada, east of Ontario. The three or



four subspecies which occur west and north of the St. Lawrence River are characterized, among other things, by their small size, dark coloration, and a tendency to have flat crania and projecting incisors, especially in the Ungava races (Rand, 1943b). The Maritime Provinces race (*acadicus*), on the other hand, is a large rather pale yellowish-brown animal with no evidence of cranial flattening or projection of the incisors. Now, because of the proximity of Newfoundland to Ungava, it would be expected that the race (*terraenovae*) occurring there would be a small, dark form much like the Ungava races. It is, therefore, surprising to find that it is large and very pale, even paler than the Maritime Provinces race, and that there is no evidence of cranial flattening.

Unfortunately, material from Ungava has been scarce until recently; otherwise a quantitative study of cranial variability could have been made. Such a study is now in progress by D. J. Osborn of Boston University. In the meantime, it is necessary to rely on colour, which is less satisfactory but in this case is nevertheless quite dependable. Comparison of a series of the Ungava races, *enixus* and *labradorius*, and a similar series of *acadicus* and *terraenovae* immediately reveals the striking difference in colour.

If the Newfoundland race, *terraenovae*, does indeed represent an offshoot of the *acadicus* complex, the question arises as to how the original colonizers managed to cross the intervening stretch of water separating Newfoundland from, say, Cape Breton Island. If they do not belong to this complex, it is necessary to assume that, although similar, the two races are actually of different derivation and resemble one another because of similar climatic conditions or other factors acting upon these two populations that have not affected the Ungava races.

It is also quite possible that the Labrador otter (*Lutra canadensis chimo*) and the Newfoundland otter (*L. c. degener*) are of separate derivation since the former is characterized by a massive skull with heavier molars, heavier zygoma, heavier mandibles, and a broader rostral region as compared with the nominate race. On the other hand, the Newfoundland race has a small weak skull with slender zygoma and lighter and weaker mandibles than the nominate race. It is, therefore, difficult to conclude that the Newfoundland form has been derived from *chimo* of Labrador. It seems more likely that both races are derived from a form similar to the nominate race, which occurs throughout southeastern Canada from Nova Scotia westward to the Manitoba border, south of the race *chimo*.

Although it is possible that few, if any, mammals colonized Newfoundland by crossing the Strait of Belle Isle, it is likely that some species were carried to the northeast coast of the island on floating ice transported by the Labrador Current, just as polar bears and Arctic foxes are brought to the island at the present time. It seems likely that the ermine, Arctic hare, and Newfoundland wolf reached the island in this way since they are more closely related to northern forms than they are to subspecies occurring in southern Canada. In their study of the now extinct Newfoundland wolf (*boethucus*), Allen and Barbour (1937) concluded that it belongs to the tundra wolf complex rather than to the timber wolves occurring in central Ungava.



Since the deer mice of Anticosti (*anticostiensis*) appear to be closer, morphologically, to the nominate race which occurs in Ungava, than to other races, it probably would be safe to assume that the original colonizers arose on the Quebec North Shore and perhaps were carried to the island by the southward extension of the Labrador Current. This insular race is characterized by a long rostrum, which is considerably longer than that of *abietorum*, the subspecies occurring in the Maritime Provinces, and *gracilis*, the subspecies from extreme southern Quebec and Ontario. There is less difference in the length of the rostrum as compared with *maniculatus*, the race occurring in Ungava. The race *anticostiensis* appears to be more like *eremus* from the Magdalen Islands than to any of the mainland forms, suggesting a relationship.

The Magdalen Islands deer mouse (*Peromyscus maniculatus eremus*) might have been expected to originate in either Prince Edward Island or Cape Breton Island, but morphologically it appears to be closer to the race occurring on Anticosti Island and to the nominate race which occurs in Ungava. This strongly suggests that the Archipelago was colonized by animals from either Anticosti or the Quebec North Shore, perhaps carried there by the Labrador and Gaspé Currents.

To recapitulate, there is some evidence, based on a study of the morphological similarities among the insular and mainland races, that a few of the species that colonized the islands arose in areas other than the nearest land mass from which they might be expected to have been derived. The following points of origin are suggested: (1) the Newfoundland meadow mouse is large and pale and appears to be closer to the race occurring in the Maritime Provinces, from which, it is suggested, it has been derived; (2) the Newfoundland otter and the Labrador otter differ more from one another than either does from the race occurring on the mainland of Eastern Canada, suggesting that the Newfoundland race is derived from animals that emigrated to the island from the Maritime Provinces; (3) the Anticosti deer mouse is closest, morphologically, to the race occurring in Ungava; and the Magdalen Islands race, in turn, is closest to the Anticosti race, strongly suggesting that both islands were colonized by animals from the Quebec North Shore.

#### DISPERSAL OF MAMMALS IN THE REGION

Since Newfoundland, Anticosti, and the Magdalens were separated from the mainland at the time of the retreat of the last ice-sheet, it is obvious, as pointed out previously, that the mammals now inhabiting them reached the islands by crossing water. It is now only possible to speculate the probable means by which colonization was possible. It is also obvious that, in most cases, there were very few invasions to the islands, and that undoubtedly each invasion consisted of very few individuals. It is also clear that, in many cases, the invasions must have taken place shortly after the retreat of the ice and that there have been few, if any, invasions since. Had there been repeated invasions, speciation would have been impossible, since the insular populations would have been constantly swamped by animals from the mainland.

The mammals may have reached the islands by any of the following means:



(1) Solid ice may have occupied much of the Gulf of St. Lawrence, thus forming a bridge connecting the islands and the mainland. It is possible that some of the larger species, such as the caribou, may have reached the islands in this way, but it is doubtful if the smaller species could have survived such a long journey without food. Within historic times, strong currents have prevented the formation of a solid bridge in the straits separating the islands and mainland. But the direction and strength of the currents may have been quite different at the time the ice-sheet was retreating, and a solid ice-mass may have been present in these straits during much of the year.

It is also possible that the retreating glaciers left moraines on the sea ice where vegetation of various types, possibly including trees, may have become established. These moraines may have provided "stepping stones" or avenues for the invading mammals which crossed to the islands.

However, had an ice bridge, with scattered vegetated moraines existed in post-glacial times, it is remarkable that so few mammals colonized the islands. If conditions were suitable for one species, they should have been equally favourable to others with similar requirements. If vegetated morainal mounds existed in the region, it must be assumed that the species now present on the islands were early arrivals. However, since invasions across inhospitable areas are generally accidental and presumably random, one species might well have been fortunate, while others failed to survive on one area sufficiently long to reach other moraines or the remote islands.

There is some evidence that certain mammal species invaded Eastern Canada shortly after the retreat of the ice, while others were slow in moving northward and are recent arrivals. It seems likely that the pine marten, meadow mouse, deer mouse, and otter were early arrivals, while the striped skunk, raccoon, and porcupine invaded the region too late to take advantage of ice bridges, land bridges, or vegetated moraines.

(2) Floating ice or rafts of vegetation may have been responsible for transporting the smaller mammals. It is probable that certain oceanic islands in tropical regions were colonized in this way (Matthew, 1939), and the coastal islands of British Columbia may have received their smaller mammals through transportation by floating debris (McCabe and Cowan, 1945; Guiget, 1953).

From time to time Arctic foxes (Cameron, 1950) and polar bears (Doutt, 1940, and Lewis and Doutt, 1942) are carried south on ice-floes of the Labrador Current, and undoubtedly other species have done likewise. It is suspected that the ermine, Newfoundland wolf, and Arctic hare reached Newfoundland in this way.

(3) In the Gulf of St. Lawrence region, vegetated "islands," carried on drifting ice, may have conveyed small mammals to the islands. On the west coast of Cape Breton Island, the writer has observed several hundred square feet of vegetated soil carried seaward on floating ice. These "islands" originate when a section of cliff, overhanging the sea, breaks away and drops to the ice below. Such land slides occur in March and April when thawing of the soil under the overhanging vegetated ledges disintegrates, removing the foundation which has hitherto supported the cliff edge. These "islands" probably have sufficient vegetation to provide food for a few small rodents for several weeks. One such "slide," examined



by the writer, on the west coast of Cape Breton Island was approximately 25 feet long by 15 feet wide. A dense growth of grasses and herbs covered almost the whole surface, and scattered clumps of small white spruce and raspberry canes occupied the centre of the area.

Should small mammals be present on the section of the cliff when it slides down onto the ice below, it is unlikely that they would abandon it since the surrounding area would be largely ice and rocks.

(4) Apart from the mammals that were introduced to the islands by man within historic time, there is also the possibility that the aborigines inadvertently transported some of the smaller species, such as the deer mouse, to Anticosti and the Magdalens. However, this is rather unlikely, since it is believed that the Indians of the region are rather recent invaders, geologically speaking, and if the deer mice had been introduced by them there would have been insufficient time for speciation to occur. Parenthetically, it should be pointed out that while the Micmacs of Prince Edward Island knew of the existence of the Magdalens and had a name for them, none of the early explorers mention having seen Indians or any evidence of them on the archipelago (Alcock, 1941).

Considering the various alternatives mentioned above, it seems quite probable that drifting ice has, in one way or another, been largely responsible for conveying most of the mammals to the three northern islands. That no true hibernators (except the bats) occur on these islands strongly suggests that colonization occurred during the winter months. Even today, as has already been pointed out, several species are known to reach the islands on ice-floes. These species, the Arctic fox and polar bear, are, however, more likely to survive a relatively long period on ice-floes than most of the mammals that have colonized the islands, because their food is taken directly or indirectly from the surrounding sea. If the fox and polar bear were carried south to Newfoundland on the ice-floes, it is also possible that Anticosti was colonized by mammals carried on ice floating out of the St. Lawrence River. Indeed, there is a slight possibility that ice-floes, carried by the Gaspé Current, transported mammals to the Magdalens.

Since, however, most of the smaller species would perish from exposure and lack of food if subjected to several weeks of isolation on an ice-floe, it must be assumed that the "floating islands" mentioned above, carried certain species or that they crossed the intervening stretches of water or ice by means of avenues of vegetated glacial moraines or "stepping stones" consisting of isolated moraines which formed "islands" between the mainland and the islands in question.

Colonization by means of "floating islands" resulting from land slides involves such a long series of very special conditions that successful transportation by this means would seem virtually impossible. First of all, the number of land slides that occur on a cliff face overhanging the sea is very small indeed, and even fewer ever reach the foot of the cliff without breaking up to such an extent as to render them uninhabitable for mammal life. Secondly, the slide must occur at a time when the sea ice is still firm and capable of bearing the tremendous weight of the earth without disintegrating. Thirdly, the ice on which the section of earth has been deposited must be carried seaward shortly thereafter, before melting has



reduced the size and thickness of the ice pan and before the limited food supply is exhausted. Fourthly, the ice pan bearing the soil and vegetation must be carried and grounded on the shores of one of the islands in the Gulf. Fifthly, the section of shore on which the pan lodges must be relatively close to vegetated areas so as to entice the mammals to leave the ice pan. If the shore is at the foot of a high cliff or has broad stretches of barren rock or sand, it is unlikely that the smaller mammals would abandon the "floating island" even under the pressure of starvation.

Incredible as it may seem, the sequence of events that led to the colonization of these northern islands must have been not unlike that just described or something equally as improbable. Indeed, the colonization of the islands by small mammals would be considered beyond the realm of possibility had we not irrefutable proof that this has been the case.

The paucity of mammal species on the three northern islands is probably due in part to the nature of the ocean currents in the Gulf. The general direction of their regular flow is such that either ice or debris carried by them would be directed toward the mainland shores rather than to the islands. A rather peculiar situation exists in this region in that the three main currents, from the coast of Labrador, the middle Atlantic, and the St. Lawrence River, converge in the Gulf to create a complex of smaller streams. In addition, in the Strait of Belle Isle area, the southward flowing Labrador Current meets the north-going stream from the Gulf and creates an

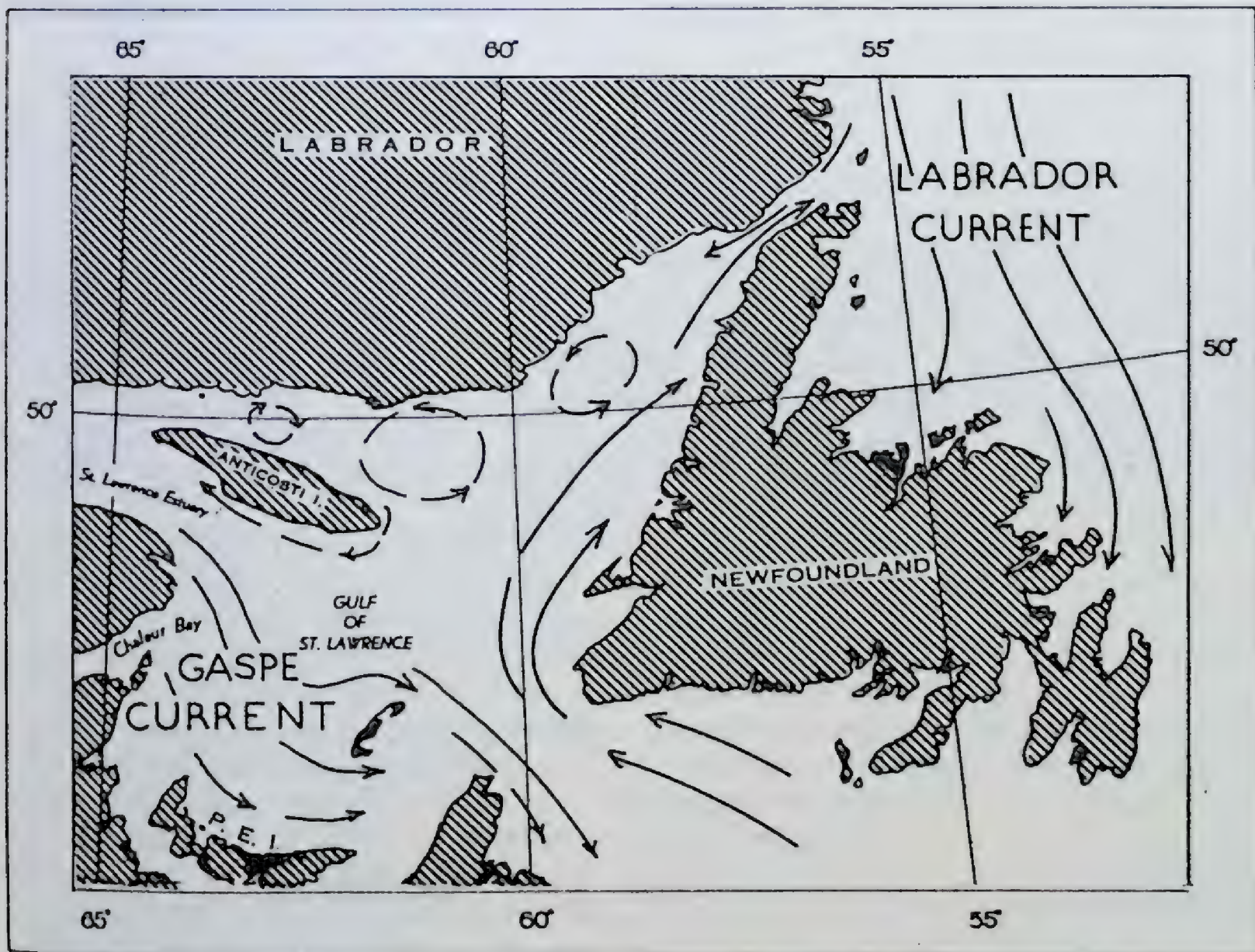


Figure 8. Courses of various currents, principally Gaspé and Labrador currents  
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area of exceptional turbulence. The Labrador Current follows the coast of Labrador, while the north-going stream skirts the west coast of Newfoundland. The turbulence created by the meeting of these conflicting currents prevents the formation of a solid ice bridge and presumably constitutes an effective barrier to mammalian dispersal in the region. It appears to have been responsible for the fact that few, if any, Ungava mammals have colonized Newfoundland.

Briefly, the direction of the currents in the Gulf might be described as flowing counter-clockwise (Figure 8). The Labrador Current continues south from the Strait of Belle Isle along the north shore of the Gulf until it reaches Anticosti Island. Here it merges with the outflow from the St. Lawrence River, and the two combine to form the Gaspé Current which flows east, surrounding the Magdalen Islands and continuing out into the Atlantic through Cabot Strait north of Cape Breton Island. On the north side of Cabot Strait, another current flows into the Gulf from the Atlantic, continues along the south shore of Newfoundland, and then rounds Cape Ray and continues along the west side of the island eventually to flow out into the Atlantic through the Strait of Belle Isle.

It is obvious from this that none of the currents, with the possible exception of the Gaspé Current, could transport mammals from the mainland to the islands. This being the case, it is probably not surprising that so few mammals have reached the islands.

The prevailing wind direction in the Gulf is westerly, and if the force is sufficient to overcome the strength of the currents, it would tend to drive ice and debris from the mainland toward the islands.

### SPECIATION IN THE INSULAR MAMMALS

In view of the relatively short time that has elapsed since the retreat of the Wisconsin ice-sheet in the Gulf of St. Lawrence region, it is remarkable that of the twenty-three mammals occurring on the three northern islands, no less than twelve have developed endemic races. As was pointed out previously, all geological and zoological evidence indicates that these islands have had no post-glacial land connections, and the present terrestrial faunas have colonized them by crossing the water barrier. The spatial isolation thus provided was evidently conducive to subspeciation, and at a surprising rate considering that the region probably has been ice-free for less than 12,000 years (Antevs, 1931).

In most cases, the insular races have differentiated to a greater degree than have the related mainland races from one another. Because of the lack of adequate series of specimens, the precise degree to which many of them differ from mainland relatives cannot be determined, but in those cases where variability has been analysed statistically, the degree of differentiation of the insular forms is quite striking. The peculiar development of the zygomatic arches in the skull of the Newfoundland beaver (*caecator*) is not evident in any other race of the species and can perhaps be interpreted as indicating that the race has almost approached the species threshold. It may, indeed, be of adaptive significance and may in some way be associated with life in the bog lakes. The Newfoundland black bear (*hamiltoni*), when compared with the nominate race which occurs throughout North America east of the Rockies, also shows striking



cranial differences. The unusual development of the skull in the fronto-parietal region and the relatively short rostrum suggest that during cranial development there is a tendency for the skull to grow vertically at the expense of overall growth resulting in a shorter skull in relation to other body measurements.

In order to assess the degree of variation in other forms, more intensive study of minor cranial characters in large series of specimens is required. A study similar to that carried out by Steven (1953) on *Clethrionomys* in the British Isles should be undertaken when additional material becomes available. At present, subspecific distinctions in many cases are based largely on colour. This seems justifiable in all those cases where the insular forms differ radically from all other races. The extremely dark, almost black pelage of the Newfoundland marten (*atrata*) sets it apart from the pale yellowish-brown colour of the eastern Canadian races. The same applies to the Newfoundland red fox (*deletrix*), which is a pale yellow and shows little of the reddish-brown coloration of mainland species. The Newfoundland otter (*degener*) is characterized by both a very dark coloration and a lightness of the zygomatic arches and dentition. Unfortunately, there is insufficient material to analyse the degree of variation quantitatively. The distinctiveness of the Newfoundland meadow mouse is based chiefly on colour, although certain cranial characters serve to differentiate it from mainland forms. The Newfoundland muskrat (*obscura*) differs from mainland forms both in pelage and cranial characters and is quite well defined.

The Newfoundland caribou is said to be quite well defined, but the writer has not seen sufficient material to state definitely to what extent it differs, quantitatively, from mainland races. However, the fact that it shows definite relationships to the woodland caribou complex is of interest in connection with the question of possible origins.

The degree of variation in cranial characters of the Anticosti deer mouse (*anticostiensis*) has been analysed quantitatively by the writer elsewhere in this paper. Examination of the graphic presentation instantly reveals that in terms of rostral length, skulls of this insular form show little overlap with those of the mainland forms. Unfortunately, no similar type of analysis has been made for the Magdalen Islands deer mouse (*eremus*), but it appears to be closer to the Anticosti and Quebec North Shore forms than to *abietorum* of the Maritime Provinces, a fact of considerable interest in connection with the question of probable origin of the colonizers.

The data on taxonomic status and degree of variation of the insular forms are discussed under the species heading for the island in question and will not be repeated here.

Several factors may have been responsible for the rapid rate of speciation among the mammals occurring on the three northern islands. It is probable that as the insular populations were not swamped by repeated invasions from the mainland, there has been only one invasion, or at least very few, shortly after the islands became habitable. And considering the barriers the mammals were obliged to overcome, it is possible that the original colonizations consisted of very few individuals. Since any small sampling of a population may not carry all the alleles present in the



species as a whole, certain genes may be selected against. At the same time, certain alleles which occur very infrequently in the parent population may be present in a much larger proportion of a small sampling and may increase tenfold in a few generations. This phenomenon has been variously known as genetic drift, scattering of variability, and the Sewall Wright effect (Wright, 1940).

Because of genetic drift, it might be said that a small group of mammals that have become isolated from the parent population is genetically different immediately. And since certain alleles occur at greater frequencies in the isolated population than they do in the parent population, the frequency is likely to increase or decrease with each succeeding generation, especially if the frequency is moderate (Dodson, 1952).

A mutation that exists in a single individual belonging to a small population may eventually spread throughout the entire population, whereas its chances of so doing in a large population are remote. By the same token, an allele that occurs very infrequently in the parent population may be completely lost, because it is not carried by any of the individuals in the small population.

The rapid rate of speciation in small populations may also be due to inbreeding, which must necessarily occur if the population consists of only a few dozen individuals. It has been suggested that the rapid evolution of elephants, deer, and wild horses is due to inbreeding (Pincher, 1949). Recessive genes present in an inbreeding population are more likely to be paired with other recessives, resulting in greater homozygosity.

Whether such changes as have occurred in the isolated populations under discussion have any adaptive significance remains to be determined. The Newfoundland caribou does not appear to be better adapted to its environment because of its large size, nor does the small size of the muskrat appear to have any survival value. Rather these appear to be the result of chance mutations that are neither advantageous nor disadvantageous. Possibly size variation is largely environmental rather than genetic as has been suggested previously for the muskrat.

## ECOLOGY OF THE ISLANDS' FAUNA

When the mammals first invaded the northern islands, it is probable that the climate was much more severe than it is at present and that the vegetated areas were much less extensive. Even today, much of the land area of both Newfoundland and Anticosti is occupied by barrens. Undoubtedly, if the initial invasions occurred shortly after the retreat of the ice, or about 11,000 years ago, the vegetated areas must have been very restricted indeed. Forest species, such as the beaver and marten, must have been obliged to adapt to conditions quite unlike those on the mainland from which they emigrated. Observations on the ecology of some of the insular mammals, made by the writer, revealed that such differences do exist.

The most striking change in habitat preferences was found in the beaver in Newfoundland. Sizable populations apparently live exclusively on the barrens where the only tree-growth consists of stunted black spruce (*Picea mariana*). Evidently they have become adapted to this unusual



environment to such an extent that they have difficulty living in the woodlands. This became evident when officials of the Newfoundland Department of Natural Resources live-trapped and transported a number of barren-ground beaver to a stream flowing through an aspen woodland where it was hoped they would become established. But within a few weeks they had abandoned the area and returned to the barrens (H. W. Walters, pers. comm.).

These beaver live in the numerous bog lakes on the barrens and apparently feed chiefly on the roots of the yellow pond lily (*Nymphaea advena*). The roots of water and pond lilies are used for building purposes, and any large trees that are required are floated through long intricate canals from the nearest stand of tall trees often growing in sheltered ravines on the barrens.

In this connection it is interesting to note that when beaver were transported from Newfoundland to Labrador in 1951, one family among several families released near Kaipokok abandoned the poplar woods and travelled several miles to a bog lake near the coast, where they have remained since. According to Mr. William A. Anderson, Wildlife Officer for Labrador, the progress of the beaver from the original site to the pond could be traced by the trees they felled en route. This strongly suggests that the beaver in question were of the "barren ground" type, and finding the woodlands unsatisfactory, they sought a bog lake to which they were accustomed.

As was mentioned elsewhere in this paper, the Newfoundland beaver is morphologically a very well-marked race and may have almost reached the species threshold. The fact that at least part of the population appears to have become almost exclusively adapted to life in bog lakes is further supporting evidence for a high degree of differentiation.

A similar situation apparently exists on the Magdalen Islands, where the writer found meadow mice living in bogs in the sand dunes rather than in the grasslands where they attain their highest densities on the mainland. While this species does occur in bogs on the mainland during peak years, it was surprising to find a fairly high density in a cranberry bog on Amherst Island when no evidence of it could be detected in the fields and meadows. Before the arrival of the white man the entire land area was heavily forested, and it is probable that when *Microtus* invaded the island, no grasslands were available. It is also possible that its presence in the bogs is due to the absence of closely-related competitive forms.

A change in habitat preference has also occurred among the meadow mice in Newfoundland. As previously mentioned, this species reaches its highest densities in grasslands on the mainland, although fairly high populations also occur in open forested areas and on dry bogs during peak years. But in Newfoundland they are as abundant in mature spruce forests as they are in grasslands, if not more so. Most of the specimens collected on the island by the writer were taken in woodlands, and mice were reported by local woodsmen throughout the entire forested region.

Since meadow mice appear to "prefer" woodland to grassland habitats on the island, it seems likely that their absence in forested areas on the mainland is due to competition with the closely-related red-backed mouse. When they colonized Newfoundland, they found this ecological niche unoccupied. If interspecific competition is indeed responsible for the



habitat preferences of the two species, the introduction of the red-backed mouse to Newfoundland should result in the replacement of the meadow mouse in the woodlands.

The abundance of *Microtus* in the forested areas may be because grassland habitats were few until farming was introduced to Newfoundland. Even today, the amount of land devoted to agricultural grassland crops is very low.

The recent restriction of the Arctic hare in Newfoundland also appears to be the result of interspecific competition. As already pointed out in the discussion on Newfoundland mammals, this hare previously occurred throughout the barrens and woodlands even in coastal areas. Following the introduction of the snowshoe hare, the Arctic hare was gradually replaced in the woodlands and now occurs only on the tops of the higher hills. This is strong evidence that the present restriction of habitat is due to competition with the snowshoe hare.

It is interesting to note in this connection that certain species now restricted to the Far North are arctic inhabitants, because they were unable to compete with closely-related southern forms. Only because they have adapted to the inhospitable northern barrens have they managed to survive (Dr. M. J. Dunbar, pers. comm.).

A similar situation exists among the hares in Great Britain. In Scotland the mountain hare (*Lepus timidus*) occupies the higher ground, while the common hare (*Lepus europaeus*) replaces it at lower levels. In Ireland, however, where only the mountain hare occurs, it is found at high and low altitudes (Lack, 1944).

This phenomenon has been observed on several islands in other parts of the world. A striking example is the chaffinch of the Canary Islands discussed by Lack (1944). These islands have received two separate invasions of the European chaffinch (*Fringilla coelops*). "In Grand Canaria and Tenerife, the earlier arrival (*F. teydea*) breeds only in the pine forests, while the less differentiated *F. c. canariensis* breeds in the chestnut and laurel forest below and in the tree-heath forest above the pine belt, but does not breed in the pine forest. On the island of Palma, *F. teydea* is not found, and the Palma form of *F. coelops* breeds not only on the chestnut and laurel, but also in the pine belt. The European chaffinch breeds freely in both broad-leaved and coniferous woodland... There is no obvious adaptive difference which fits the Canary Blue Chaffinch (*F. teydea*) for pine woods and tree-heath, but the distribution of these species is only explicable on the view that such an adaptive difference exists."

Another example is that of the tree creeper (*Certhia*) on the European continent and in Great Britain. On the continent, one species, *Certhia familiaris*, is found only in the coniferous forests while *C. brachydactyla* occurs in broad-leaved woods. But in England where *brachydactyla* does not occur, *familiaris* is found in both coniferous and deciduous forests (Tucker, 1949).

Though of quite a different nature, the restriction of habitat of the Anticosti deer mouse is due to the presence of the white-tailed deer. As mentioned previously, the deer have denuded the forests of shrubs and young trees to such an extent that the only well-vegetated areas are the soil-covered roots of upturned trees which are elevated beyond their reach. Here only, does suitable habitat for the mice appear to exist.



## SUMMARY

The present paper is the result of a seven-year study of the mammals that occur, or are known to have occurred within historic time on Newfoundland, Anticosti, the Magdalens, Prince Edward Island, and Cape Breton Island. With the exception of Anticosti, the report is the first comprehensive treatment of the mammalian faunas of these islands. Each species is treated, by island, with comments on its taxonomic status, where necessary, and with a general discussion on such topics as distribution, numerical status, and ecology. Maps are included showing the distribution of most of the species in the region.

Island faunas in general are discussed, and their importance as natural laboratories for evolutionary studies is emphasized. It is pointed out that since isolation of one form or another is necessary before speciation is possible, islands have played an extremely important role in organic evolution. The mammalian fauna of each island is compared with that of the other islands in the Gulf and with that of the adjacent mainland, and these faunas are in turn compared with those of the British Isles and the Japanese Archipelago.

The following are brief résumés of the mammalian faunas of the islands:

**Cape Breton Island.** Thirty-five species have been recorded for the island, of which two have been inadvertently introduced by the white man. Five of the thirty-three native species have been exterminated within historic time, but two have recently been re-introduced and appear to be thriving. Four species—the woodchuck, raccoon, striped skunk, and porcupine—are absent on the island, though common in eastern peninsular Nova Scotia. The smoky shrew is recorded from the island for the first time. The Arctic fox has been recorded on the island on two occasions. Apart from these exceptions, the species composition is essentially like that of the neighbouring mainland, but certain species, such as the deer mouse and chipmunk, which are common on the mainland, are scarce on the island. The island has no endemic races.

**Prince Edward Island.** Of the thirty-two species that occur on Prince Edward Island, or have occurred there within historic time, four are now extinct, and five have been introduced. At least five species that occur in neighbouring Nova Scotia and New Brunswick are not native to the island; among them are the woodchuck, raccoon, striped skunk, and porcupine. The woodland jumping mouse, smoky shrew, and northern flying squirrel are definitely recorded for the first time. There are no subspecies restricted to the island. Since 85 per cent of the land area has been cleared for agricultural purposes, it is not surprising that most of the larger forest species are either rare or have been exterminated within the last three centuries.



**Anticosti.** Only five species—the black bear, pine marten, otter, red fox, and deer mouse—are native to the island. No less than twelve species have been introduced, but of these only six still occur. The white-tailed deer has been the most successful of the introduced species, and the writer estimates that the population in 1952 could not be less than 350,000. The Arctic fox has been recorded on two occasions but is non-resident. One endemic subspecies occurs on the island—the Anticosti deer mouse.

**The Magdalen Islands.** The deer mouse, meadow mouse, snowshoe hare, and red fox occur on the archipelago and may be native. The occurrence of the meadow mouse on the islands was unsuspected until 1952 when the writer collected a series of six. The Magdalen Islands deer mouse is a subspecies restricted to the archipelago.

**Newfoundland.** The mammalian fauna of the island of Newfoundland, like those of Anticosti and the Magdalen Islands archipelago, is depauperate in species. Only fourteen species, belonging to five orders, are native. There are no shrews or moles and only one species of mouse. The Arctic fox and polar bear are visitors from the Arctic. The Newfoundland wolf, an endemic subspecies, is now extinct, and the Arctic hare and pine marten are rare. Five species have been introduced, two of which, the moose and snowshoe hare, are of considerable economic importance. Of the fourteen native species, ten have endemic races on the island. The black bear (*hamiltoni*) was recently described by the writer as a new subspecies. All of the endemic forms are regarded by the writer as subspecies of mainland species.

The region under consideration was almost, if not totally, ice-covered during the last glacial period, and if any unglaciated areas were present, it is unlikely that they could have served as refuges for mammals. During the period of maximum glaciation, it is postulated that the mammals now occurring in Eastern Canada were concentrated in the southeastern United States. The writer also supposes that the Appalachian Mountain range, with its local montane glaciers and the St. Lawrence River constituted effective barriers and that the mammals east and west of the range were virtually isolated from one another. As the ice retreated and the previously glaciated areas became habitable, the mammals occupying the coastal side of the range moved northward and eventually colonized the Maritime Provinces and possibly Newfoundland. Those west of the range eventually invaded Ungava, and a few colonized Anticosti and probably the Magdalens. The probable origin of some of the insular mammals could be inferred by comparing the degree of similarity between the subspecies occurring on the islands and the various subspecies on the mainland. Three and possibly four of the Newfoundland subspecies appear to have been derived from Maritime Provinces stock, while the deer mice of Anticosti and the Magdalens show a definite affinity to the deer mice of Ungava.

Ungava and Newfoundland probably became habitable less than 12,000 years ago; the southern islands were probably favourable for mammalian colonization somewhat earlier. The available geological evidence



indicates that Newfoundland, Anticosti, and the Magdalens were cut off from the mainland before the retreat of the ice; therefore the mammals now occurring on them were obliged to cross a water barrier. The geological evidence for or against post-glacial land connections between Prince Edward Island and Cape Breton Island, and the adjacent mainland is inconclusive. Zoological evidence compiled by the writer, however, leaves little doubt that these islands have been joined to the mainland by land bridges since the retreat of the ice.

Because of their wide distribution in the region and occurrence on all five of the islands, it is concluded that the black bear, pine marten, otter, and red fox were early arrivals to the region. Conversely, the absence of the woodchuck, raccoon, striped skunk, and porcupine on all of the islands strongly suggests that they were late arrivals. The writer concludes that they invaded Eastern Canada after the land bridges to the two southern islands had disappeared.

Since less than 50 per cent of the mammals occurring in the Maritime Provinces and Ungava are found on Newfoundland, Anticosti, and the Magdalens, it is quite obvious that the straits separating the islands from the mainland are very effective barriers. At the present time the ocean currents in the Gulf are of such a nature that it would be extremely difficult for mainland mammals to reach the islands. The effectiveness of the water barriers is further attested by the fact that no less than twelve of the twenty-three mammals occurring on these islands have developed endemic races. Had there been repeated invasions from the mainland, the island populations would have been continually swamped and subspeciation would have been impossible.

It is now only possible to speculate as to the means by which the mammals originally reached the islands. Floating debris, floating ice, ice bridges, vegetated moraines, and ice-borne vegetated "islands" of soil are all suggested. It seems probable that colonization occurred during the winter months as there are no true hibernators on the islands, except the bats.

The species composition of each island differs from that of the other islands and the adjacent mainland. Colonization of the three northern islands appears to have been purely random as the present species composition exhibits no logical pattern. Anticosti and Newfoundland have each only a single small rodent but of different species. Such common and widespread mainland species as the red squirrel and red-backed mouse, to mention only two, are absent on the three northern islands. The arboreal pine marten is present on two of the islands, but the closely-related aquatic mink is absent on all three.

Most of the endemic races are well defined and differ from their mainland relatives to a greater degree than the mainland subspecies differ from one another. Since the islands could not have been ice-free for more than 12,000 years, the relatively high degree of differentiation which is apparent in the insular races, is surprising. It has heretofore been assumed that subspeciation in mammals requires a period in the order of 50,000 years. The writer suggests that there were very few colonizations by any



one species and that each colonization consisted of very few individuals. Therefore, inbreeding has probably been partially responsible for the rapid rate of subspeciation.

There have been a number of remarkable changes in the ecology of the island mammals. At least part of the beaver population in Newfoundland has become adapted to life in the bog lakes on the barrens, and all efforts to establish them in forested areas have been futile. The meadow mice in Newfoundland occur throughout the forested regions and appear to attain their highest densities in woodland habitats, in sharp contrast to those on the mainland, which normally occur in grasslands. Absence of a closely-related competitive species, such as the red-backed mouse, is suggested by the writer as the probable explanation for the appropriation by the meadow mouse of an ecological niche, which it seldom invades on the mainland. On the Magdalens, meadow mice were found in isolated bogs on the sand dunes, but none were seen or collected in the grasslands where they might be expected to occur. Evidently as a result of interspecific competition, the Arctic hare of Newfoundland is now found only on the barren tops of the higher hills, though it occurred throughout the woodlands before the introduction of the snowshoe hare.



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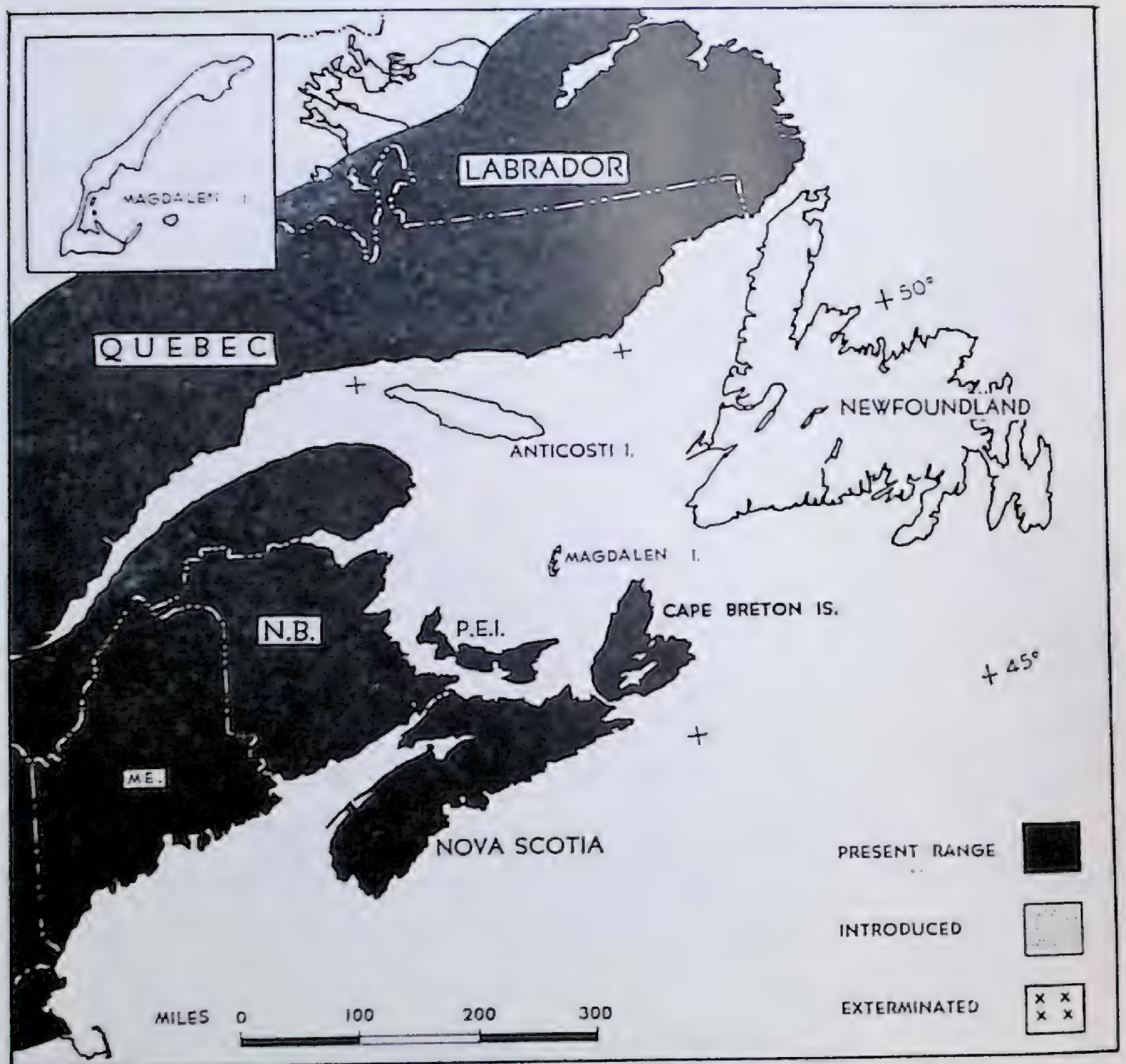


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## DISTRIBUTION MAPS

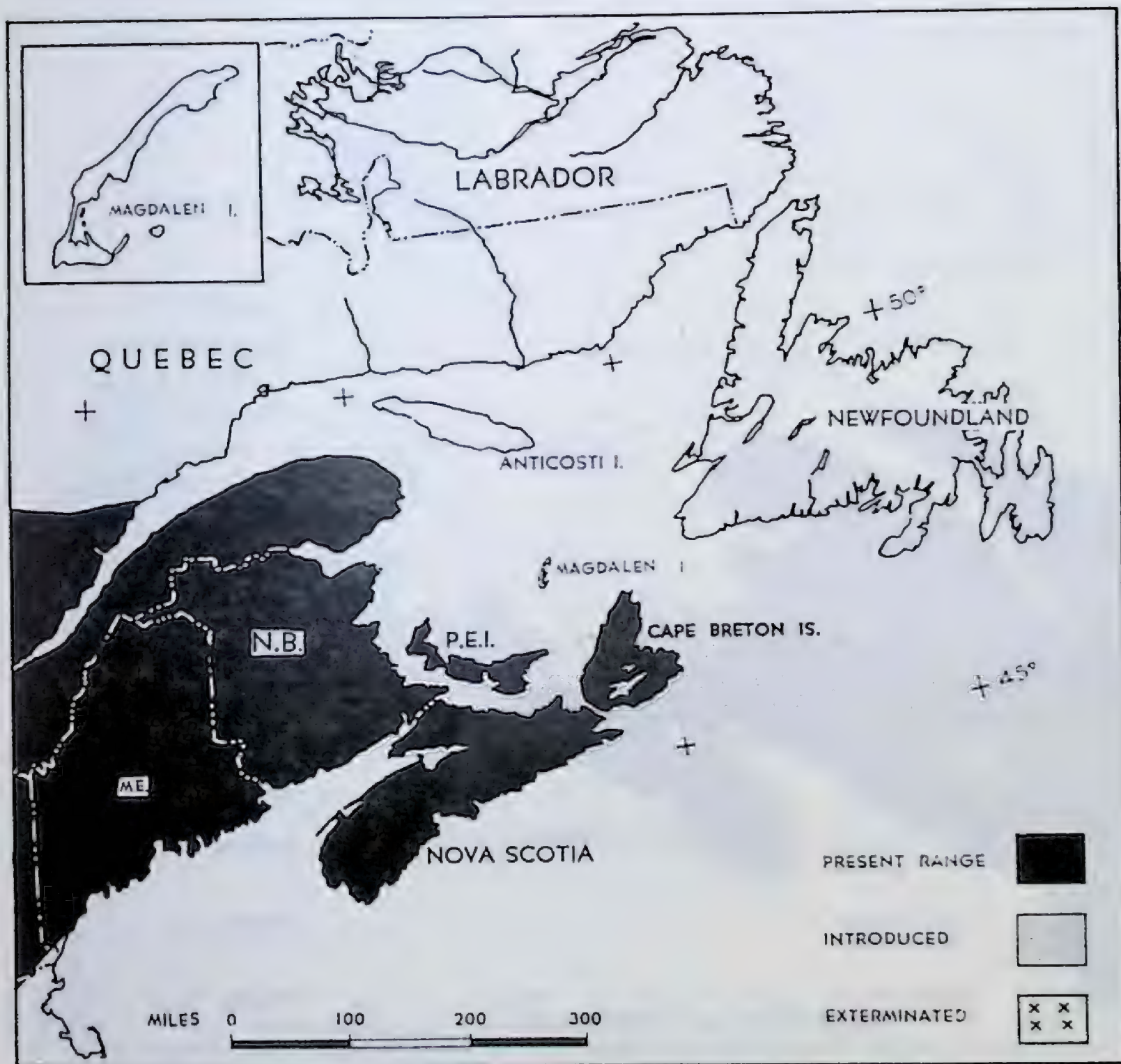
The following maps have been prepared to show the distribution of the mammals occurring on the islands in the Gulf of St. Lawrence and the adjacent mainland. Ranges as shown for the interior of Ungava and the New England States are only approximate.



DISTRIBUTION MAP No. 1

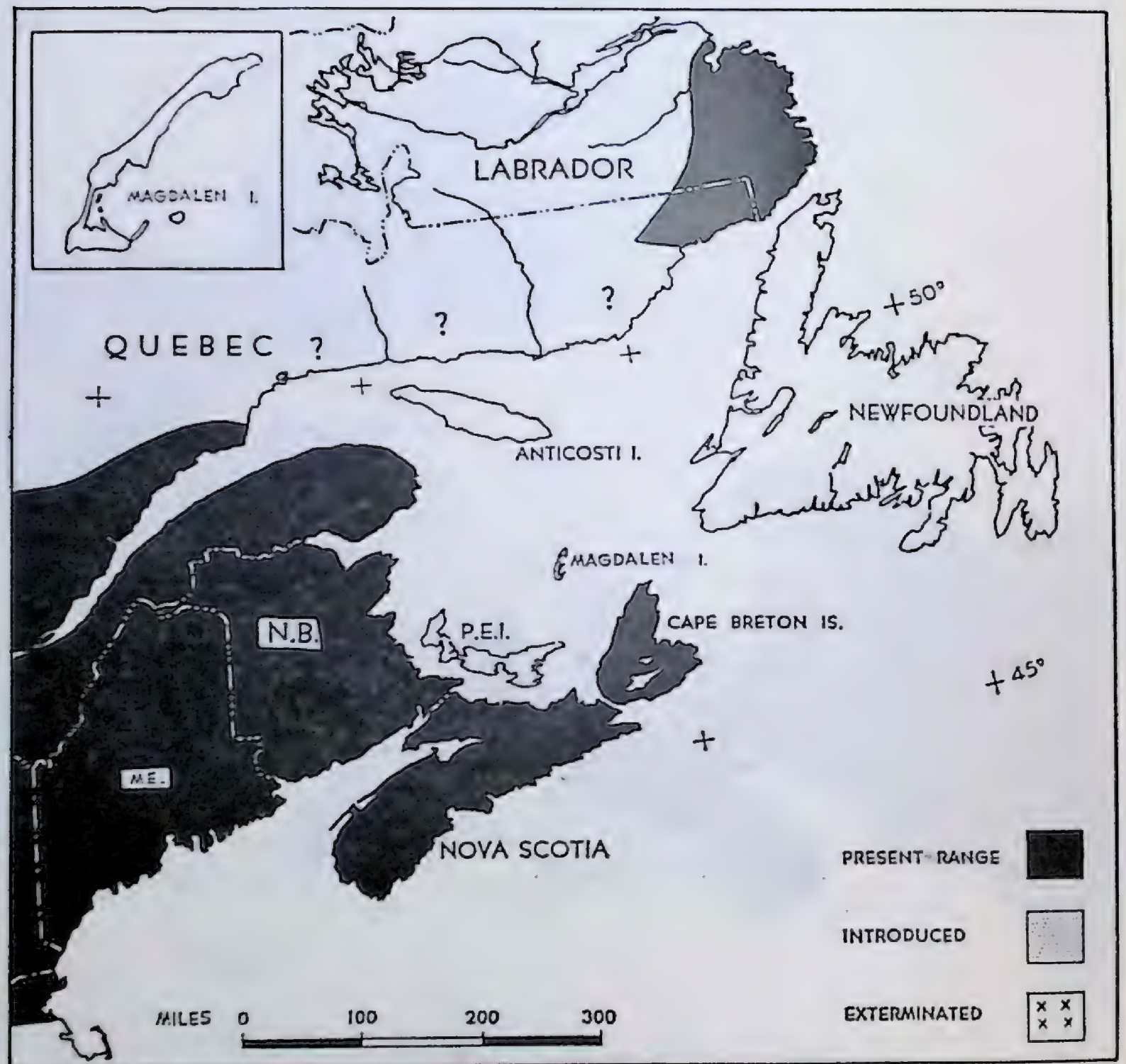
- Cinereous shrew *Sorex cinereus* Kerr  
 Red squirrel *Tamiasciurus hudsonicus* (Erxleben)  
 Flying squirrel *Glaucomys sabrinus* (Shaw)  
 Red-backed mouse *Clethrionomys gapperi* (Vigors)  
 Meadow jumping mouse *Zapus hudsonius* (Zimmerman)  
 Woodland jumping mouse *Napaeozapus insignis* (Miller)





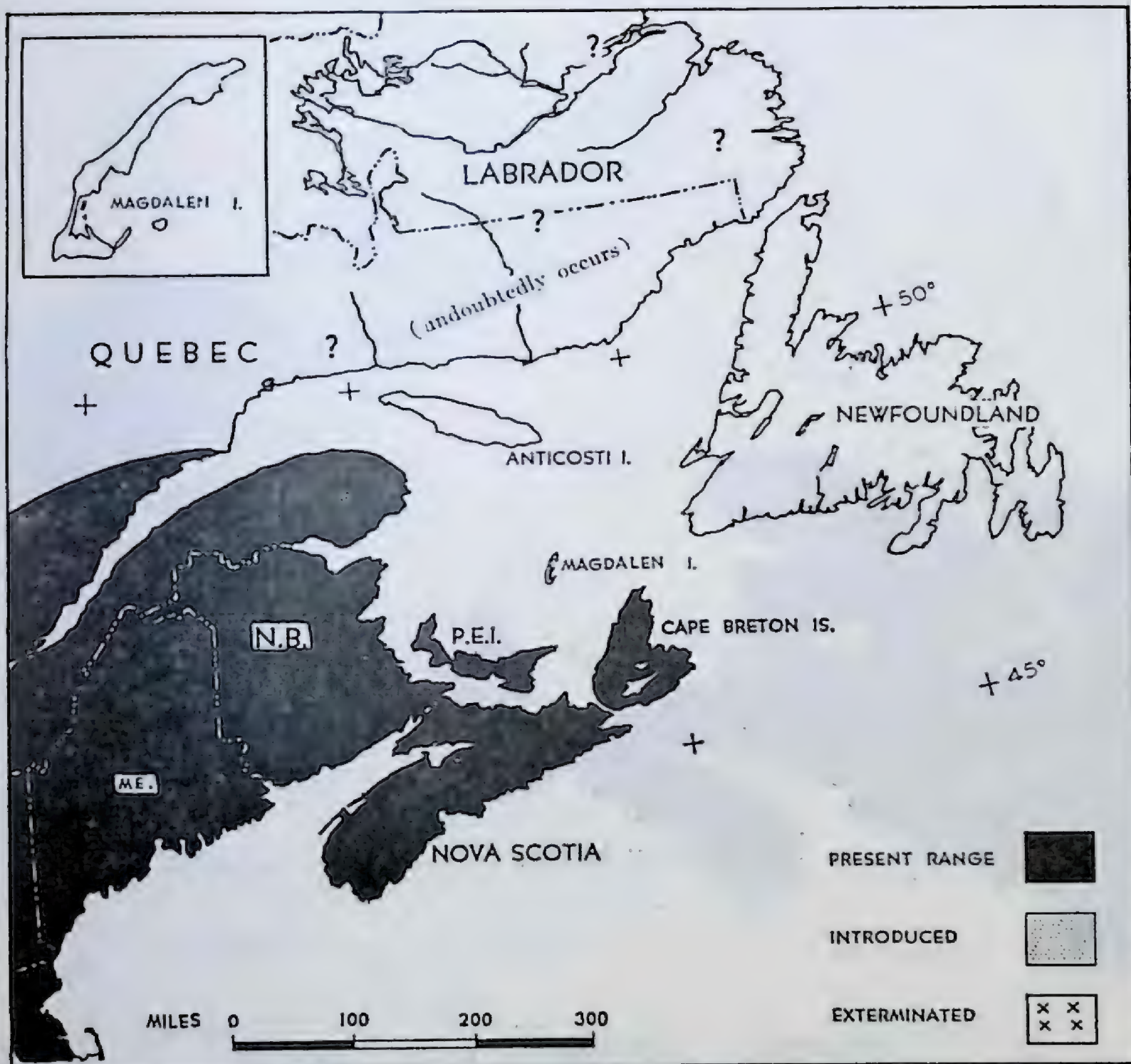
DISTRIBUTION MAP No. 2  
Smoky shrew *Sorex fumeus* Miller





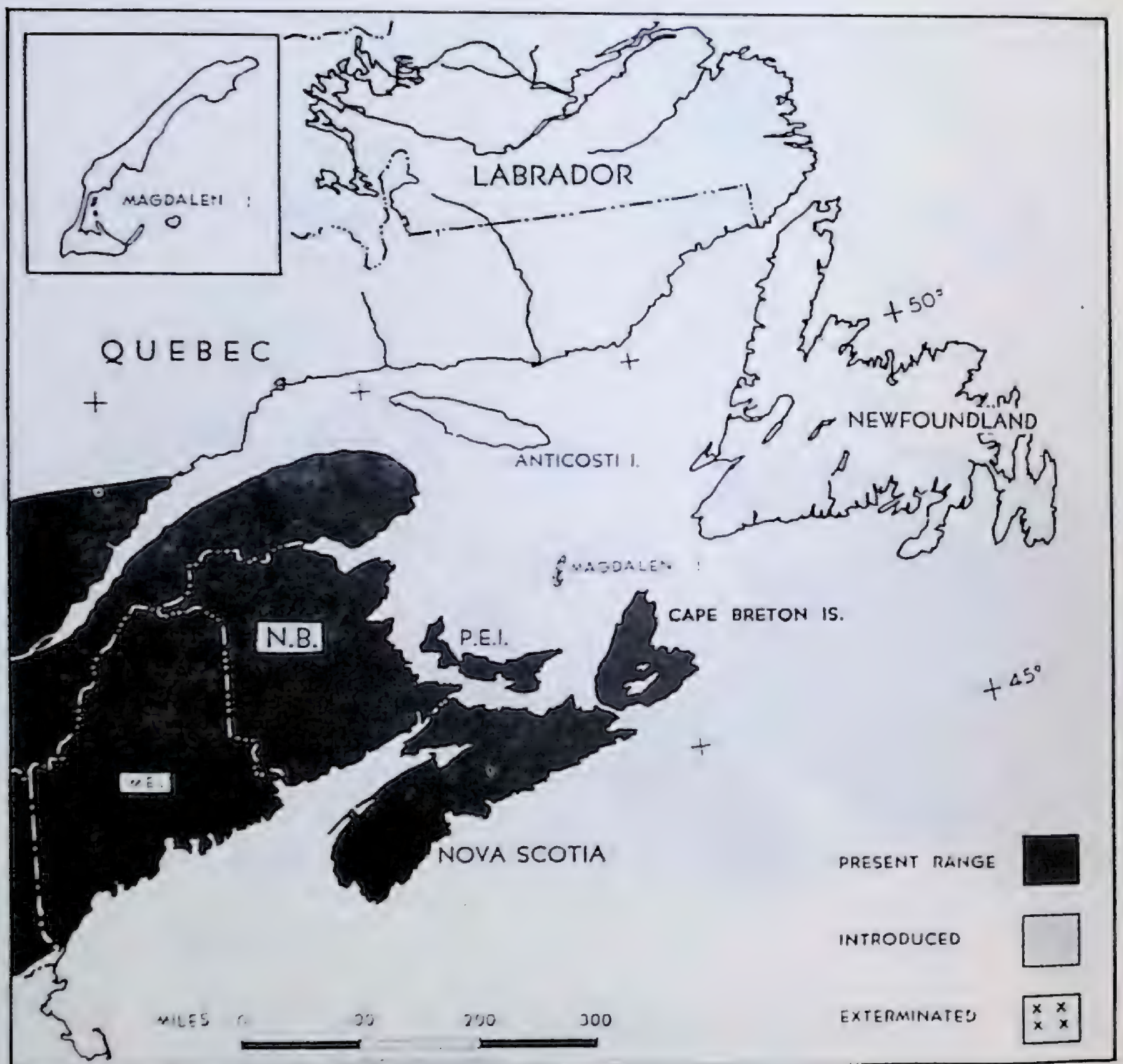
DISTRIBUTION MAP No. 3  
Water shrew *Sorex palustris* Richardson





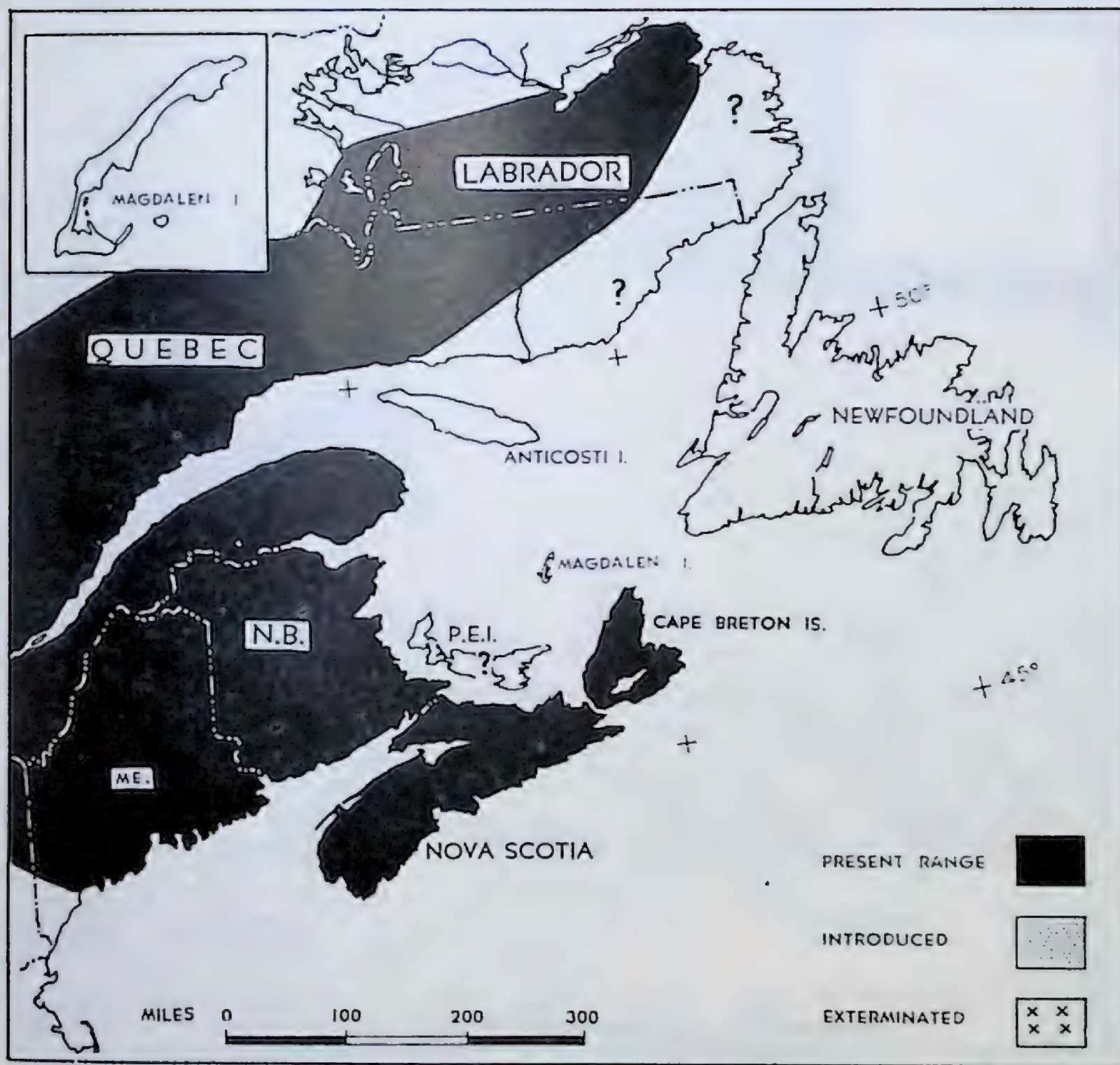
DISTRIBUTION MAP No. 4  
Pigmy shrew *Microsorex hoyi* (Baird)





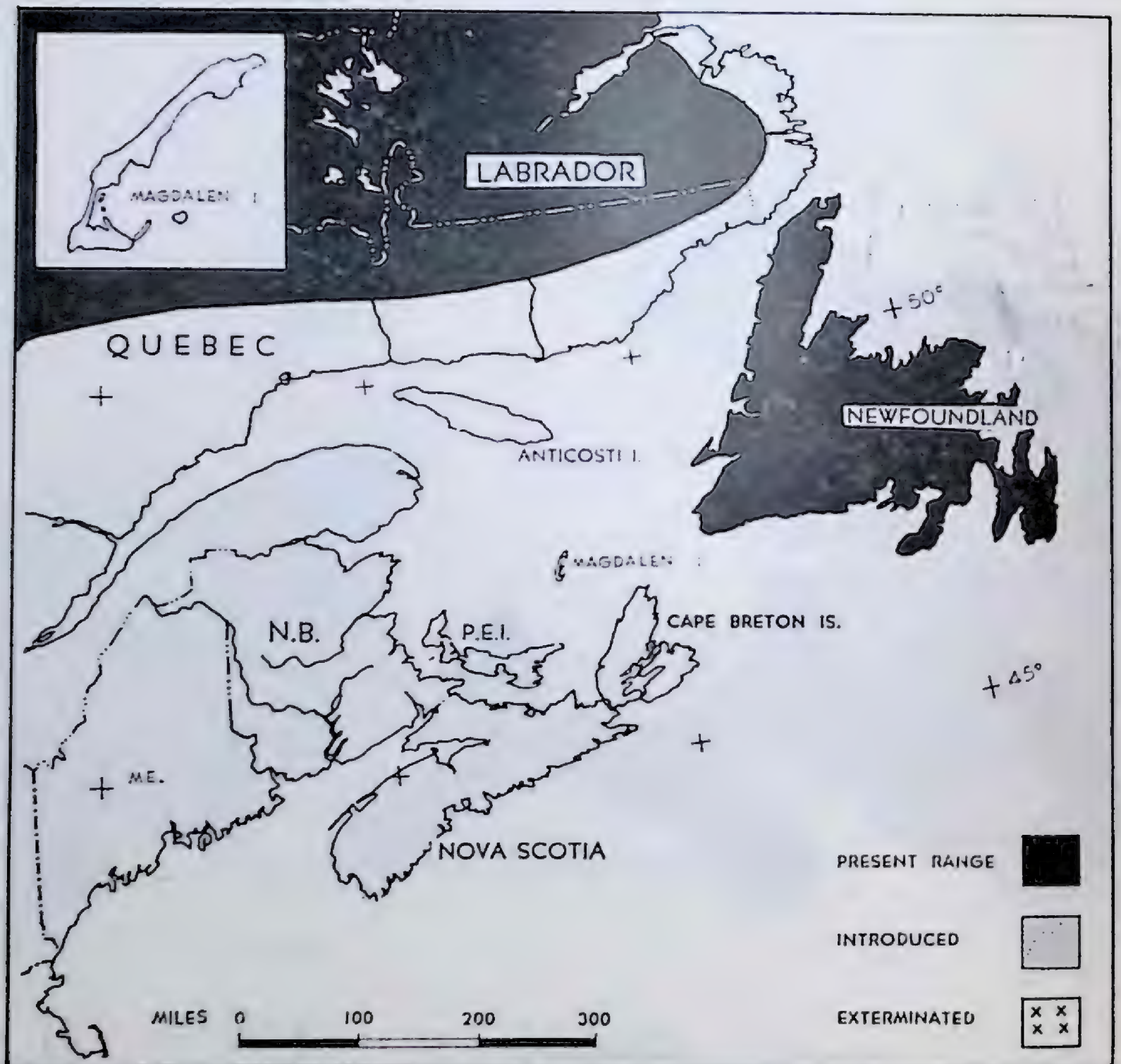
DISTRIBUTION MAP No. 5  
Short-tailed shrew *Blarina brevicauda* (Say)





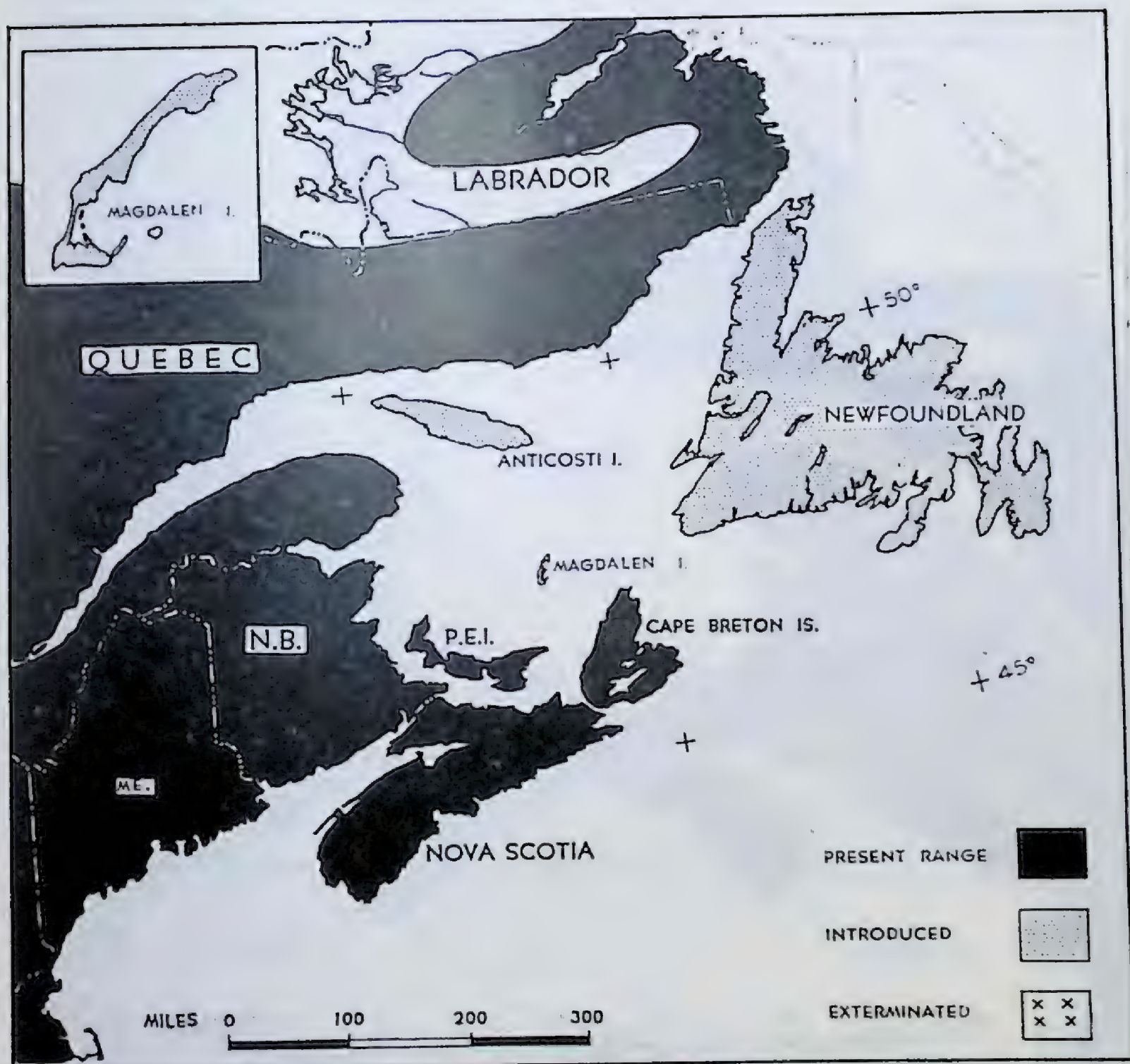
DISTRIBUTION MAP No. 6  
 Star-nosed mole *Condylura cristata cristata* (Linnaeus)





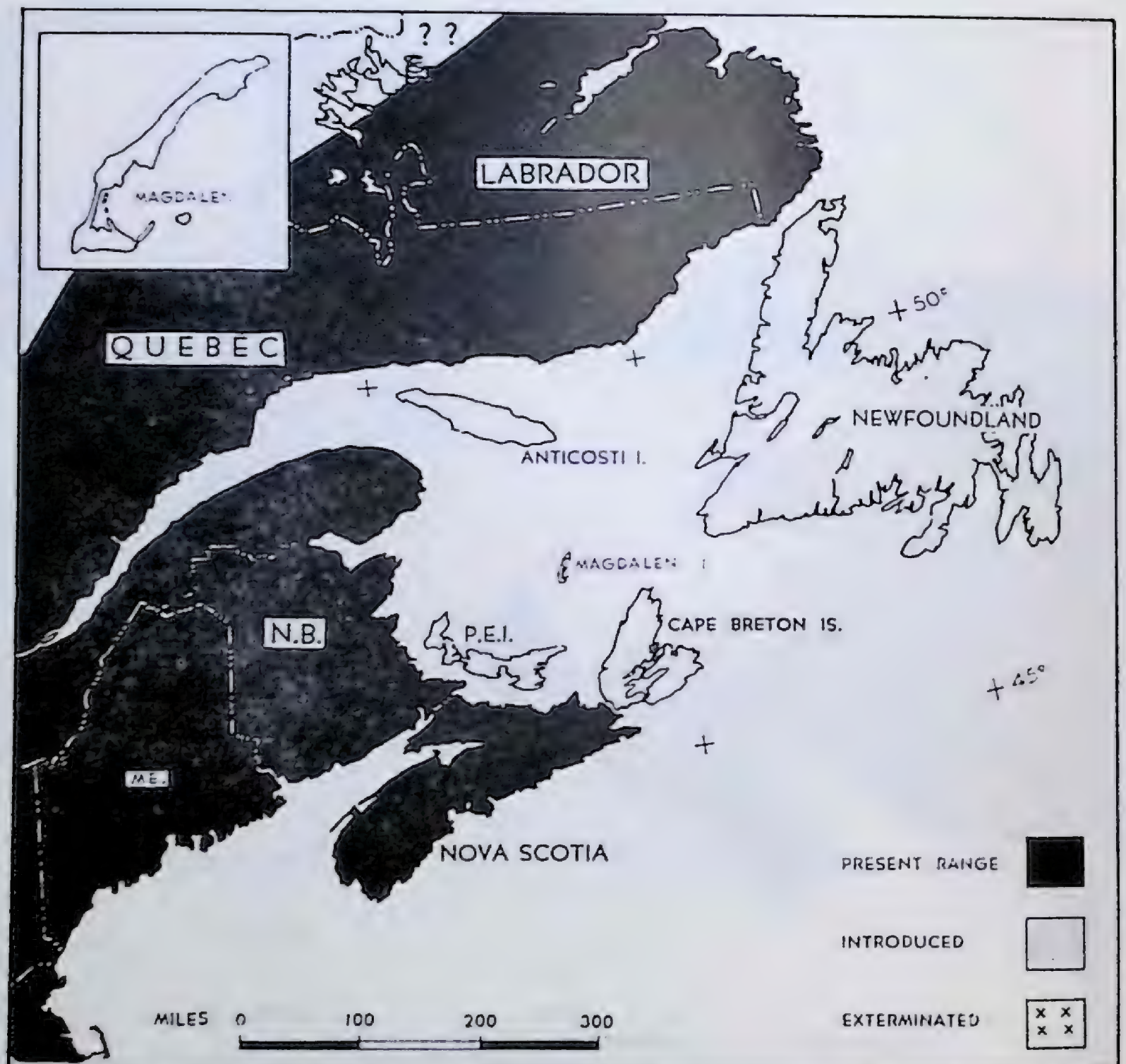
DISTRIBUTION MAP No. 7  
 Arctic hare *Lepus arcticus* Ross





DISTRIBUTION MAP No. 8,  
Snowshoe hare *Lepus americanus* Erxleben

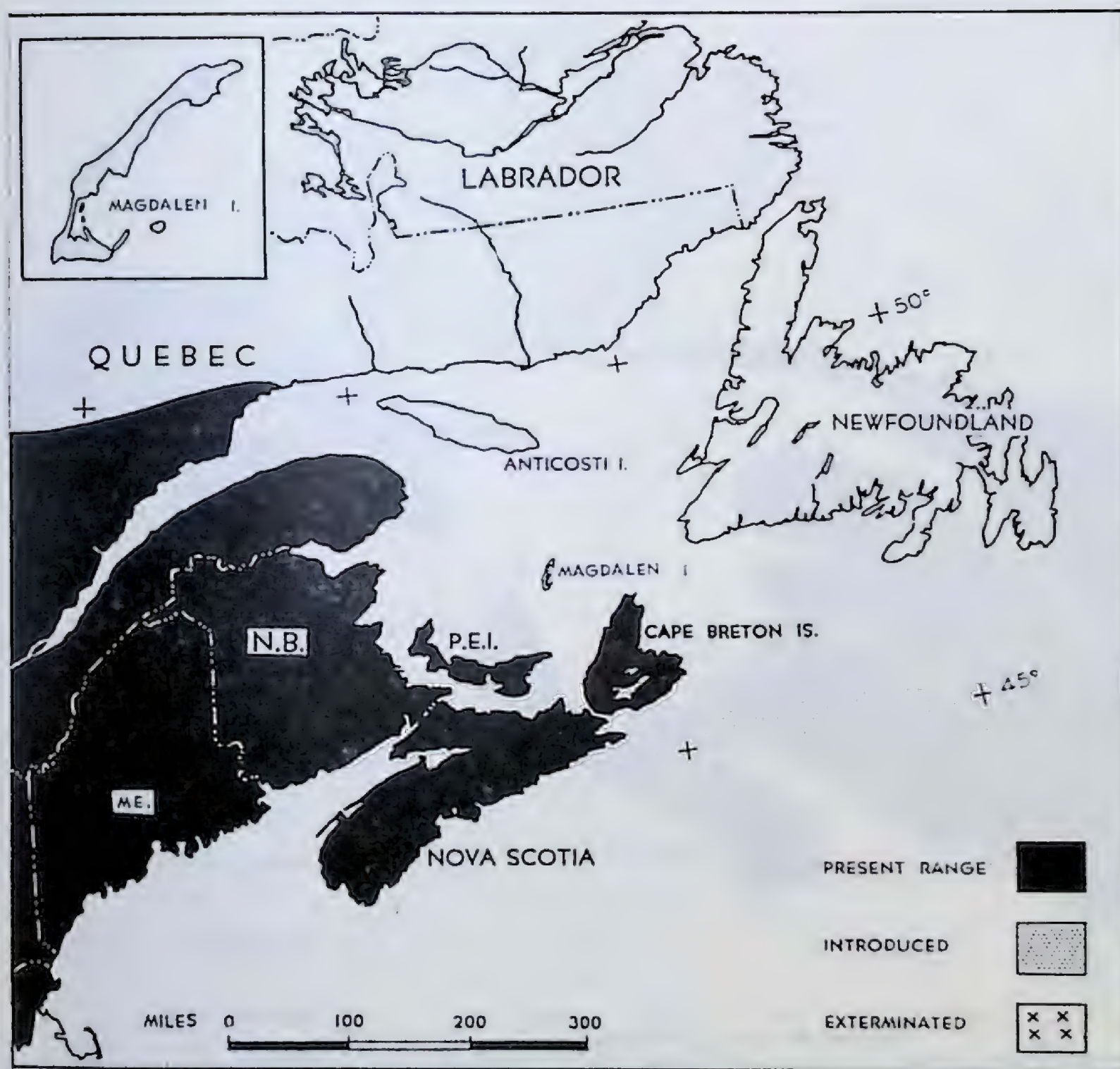




DISTRIBUTION MAP No. 9

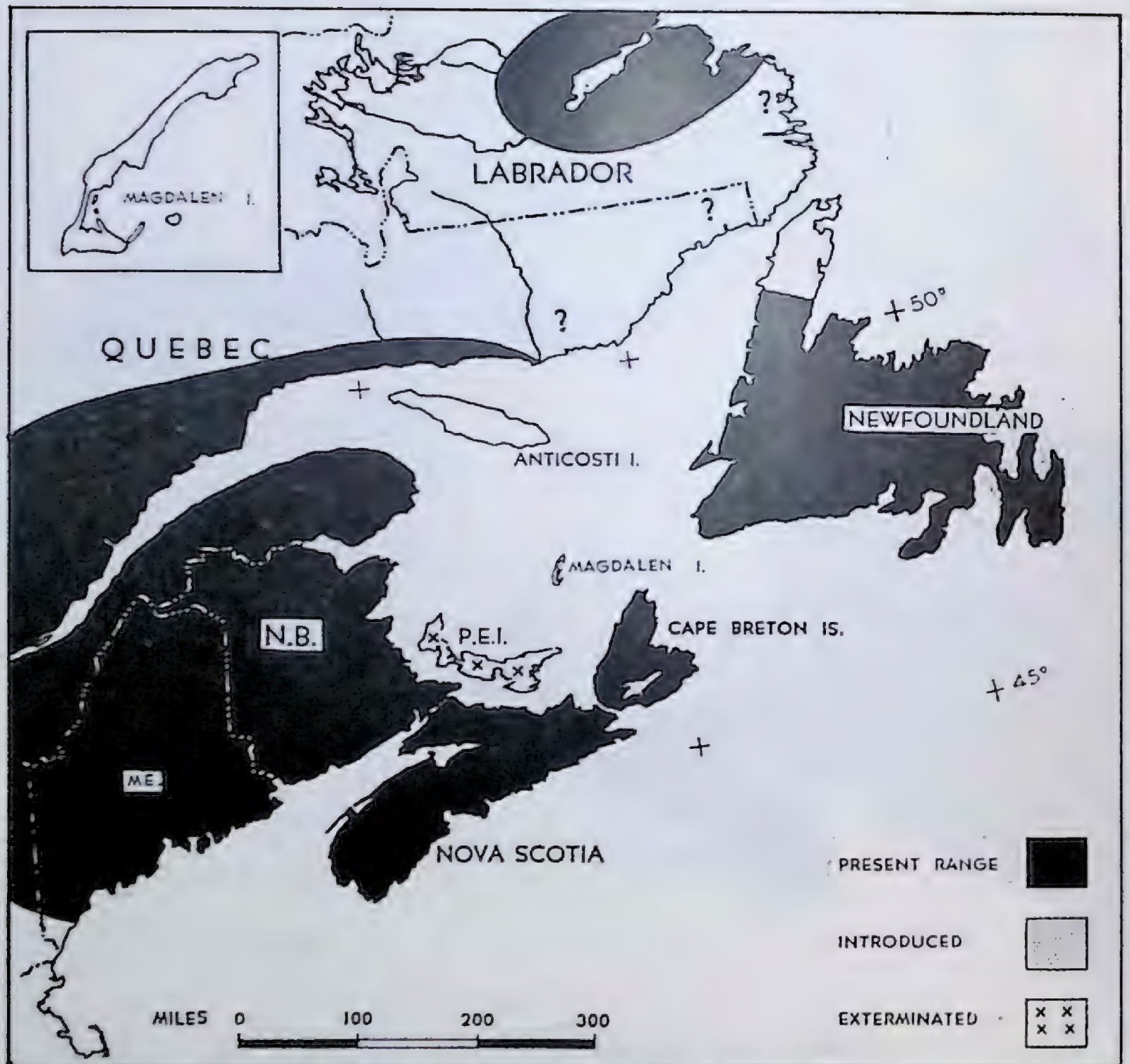
Woodchuck *Marmota monax* (Linnaeus)  
 Porcupine *Erethizon dorsatum* (Linnaeus)





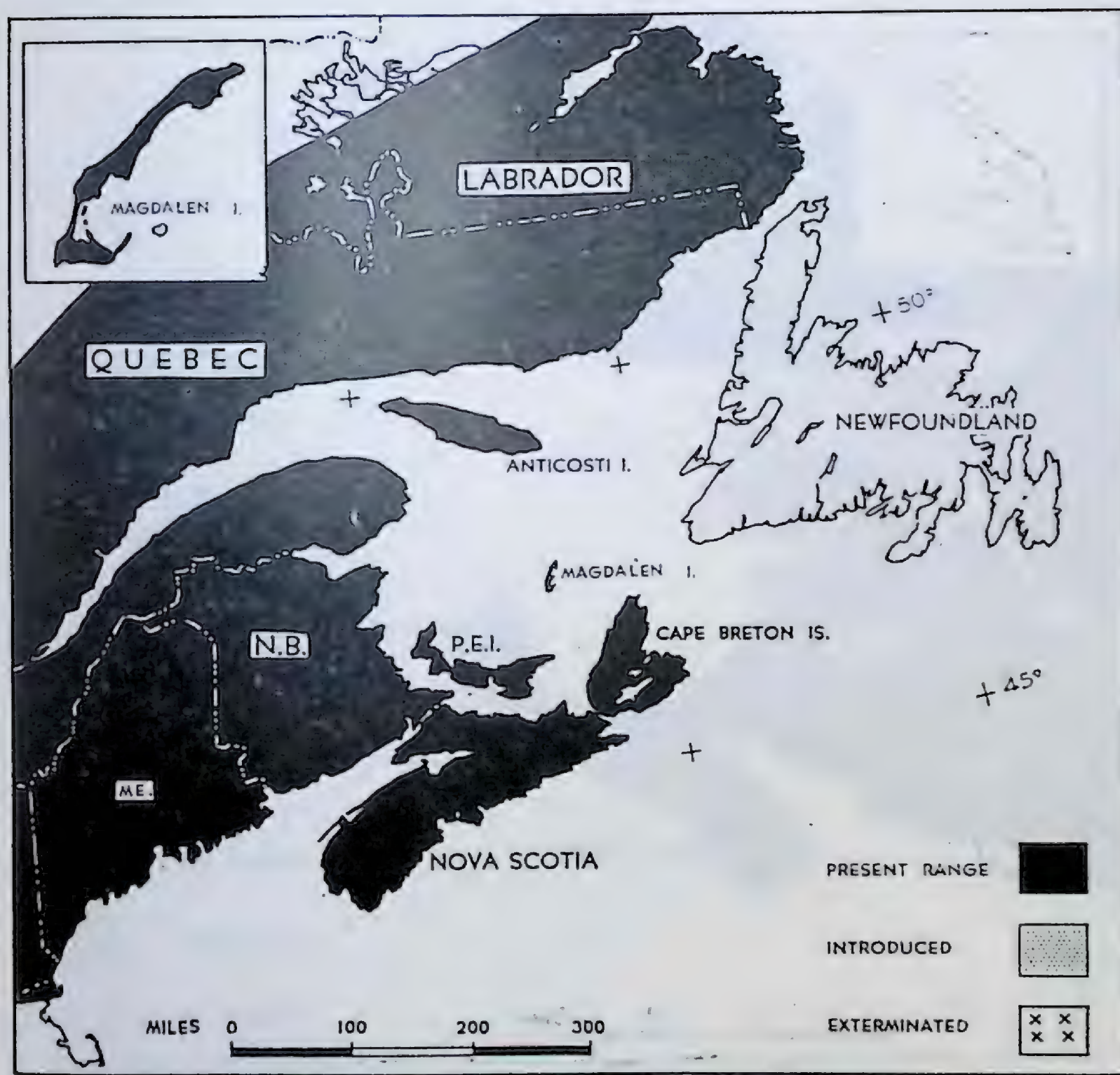
DISTRIBUTION MAP No. 10  
 Eastern chipmunk *Tamias striatus* (Linnaeus)





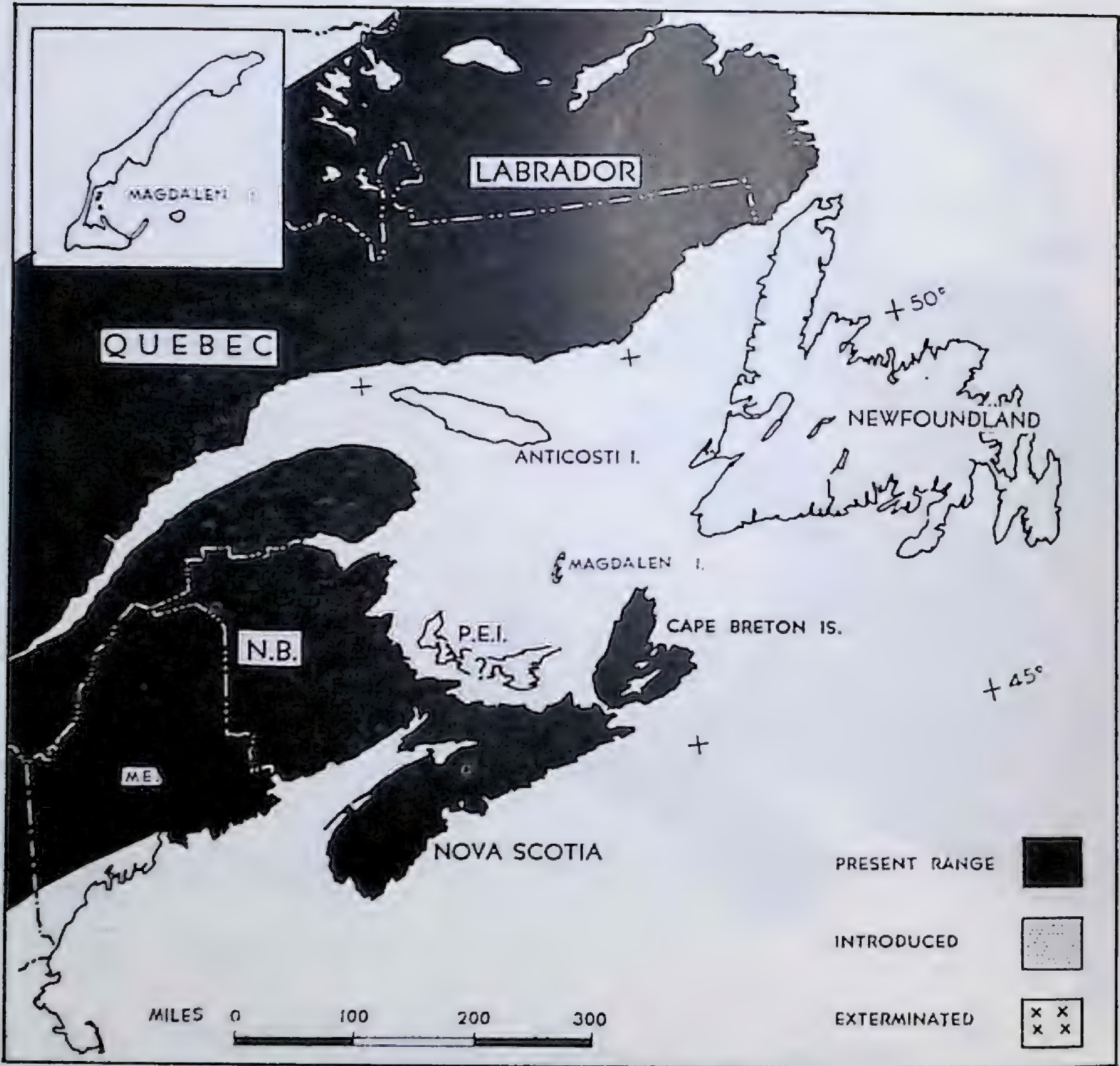
DISTRIBUTION MAP No. 11  
Beaver *Castor canadensis* Kuhl





DISTRIBUTION MAP No. 12  
Deer mouse *Peromyscus maniculatus* (Wagner)





DISTRIBUTION MAP No. 13  
Bog lemming *Synaptomys*





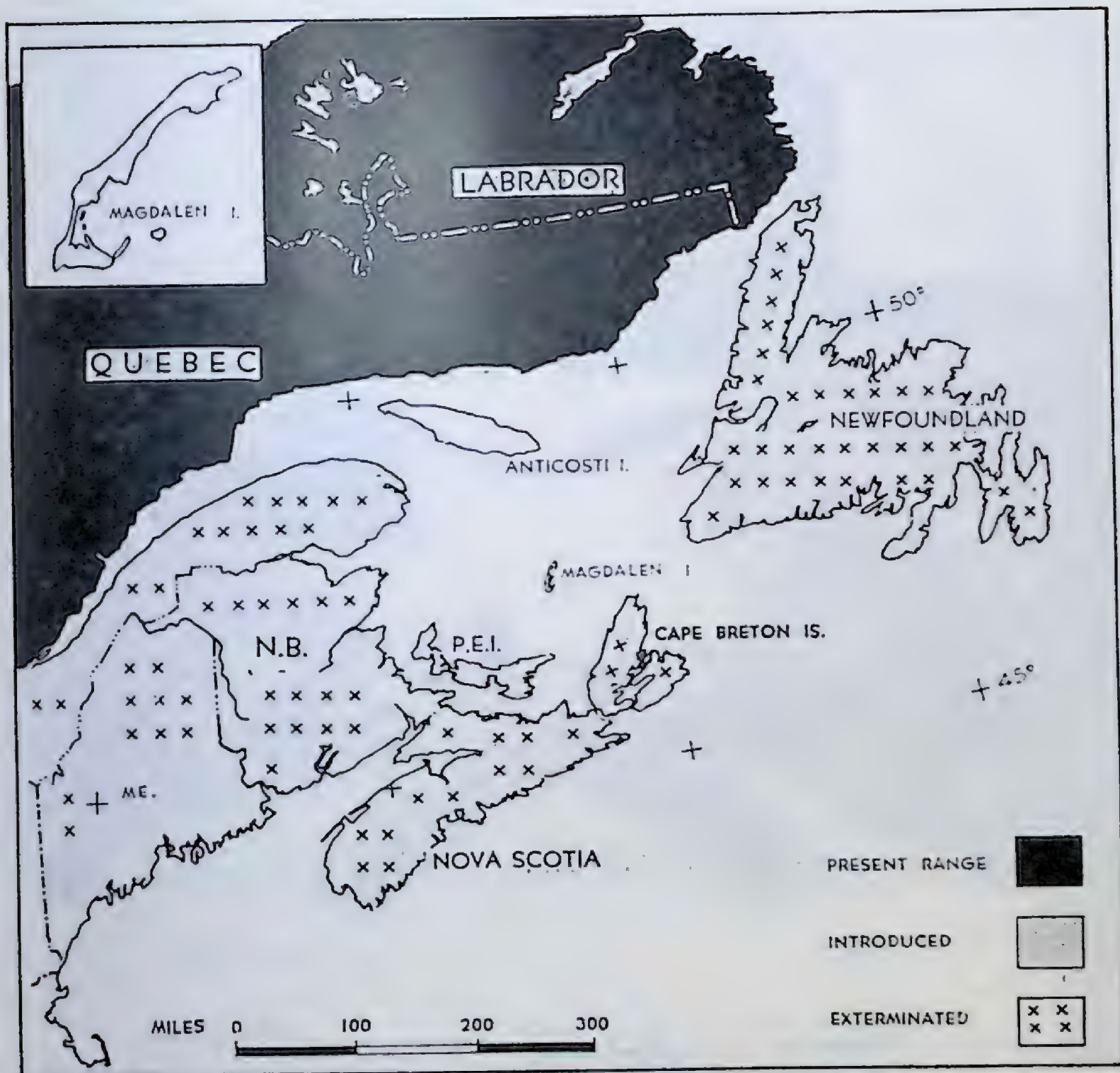
DISTRIBUTION MAP No. 14  
Meadow mouse *Microtus pennsylvanicus* (Ord)





DISTRIBUTION MAP No. 15  
Muskrat *Ondatra zibethicus* (Linnaeus)





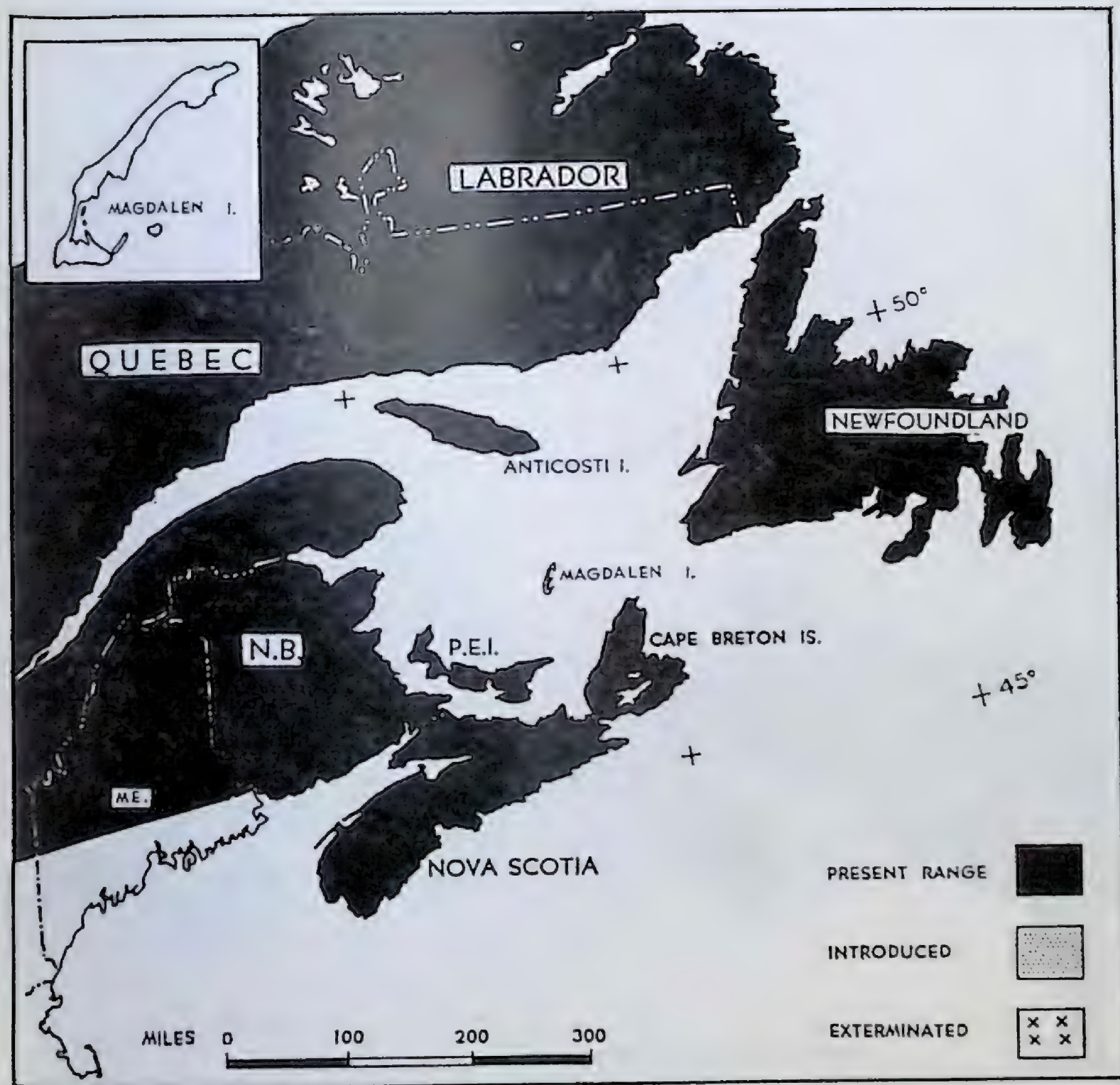
DISTRIBUTION MAP No. 16  
 Wolf *Canis lupus* Linnaeus





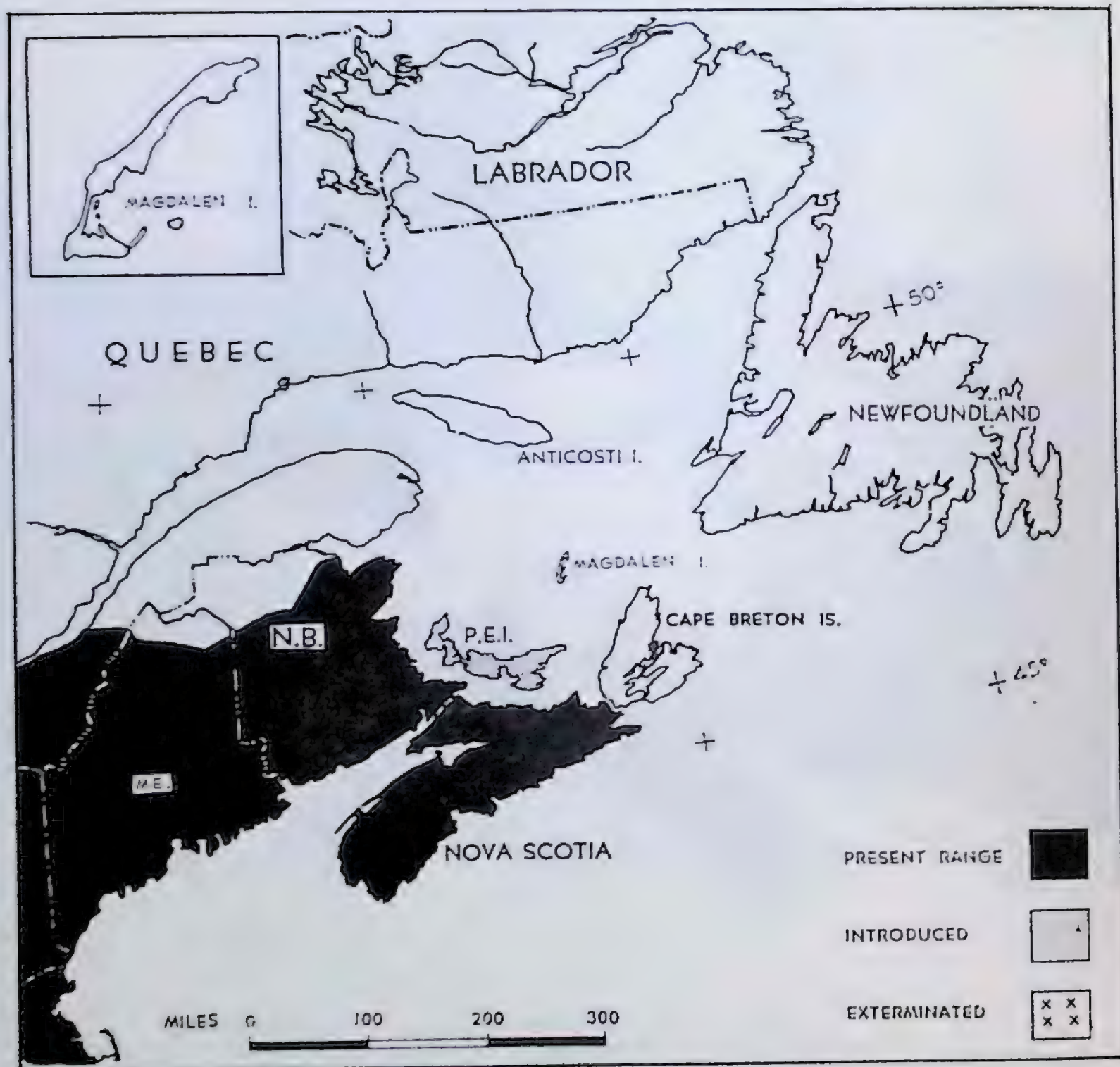
DISTRIBUTION MAP No. 17  
Red fox *Vulpes fulva* (Desmarest)





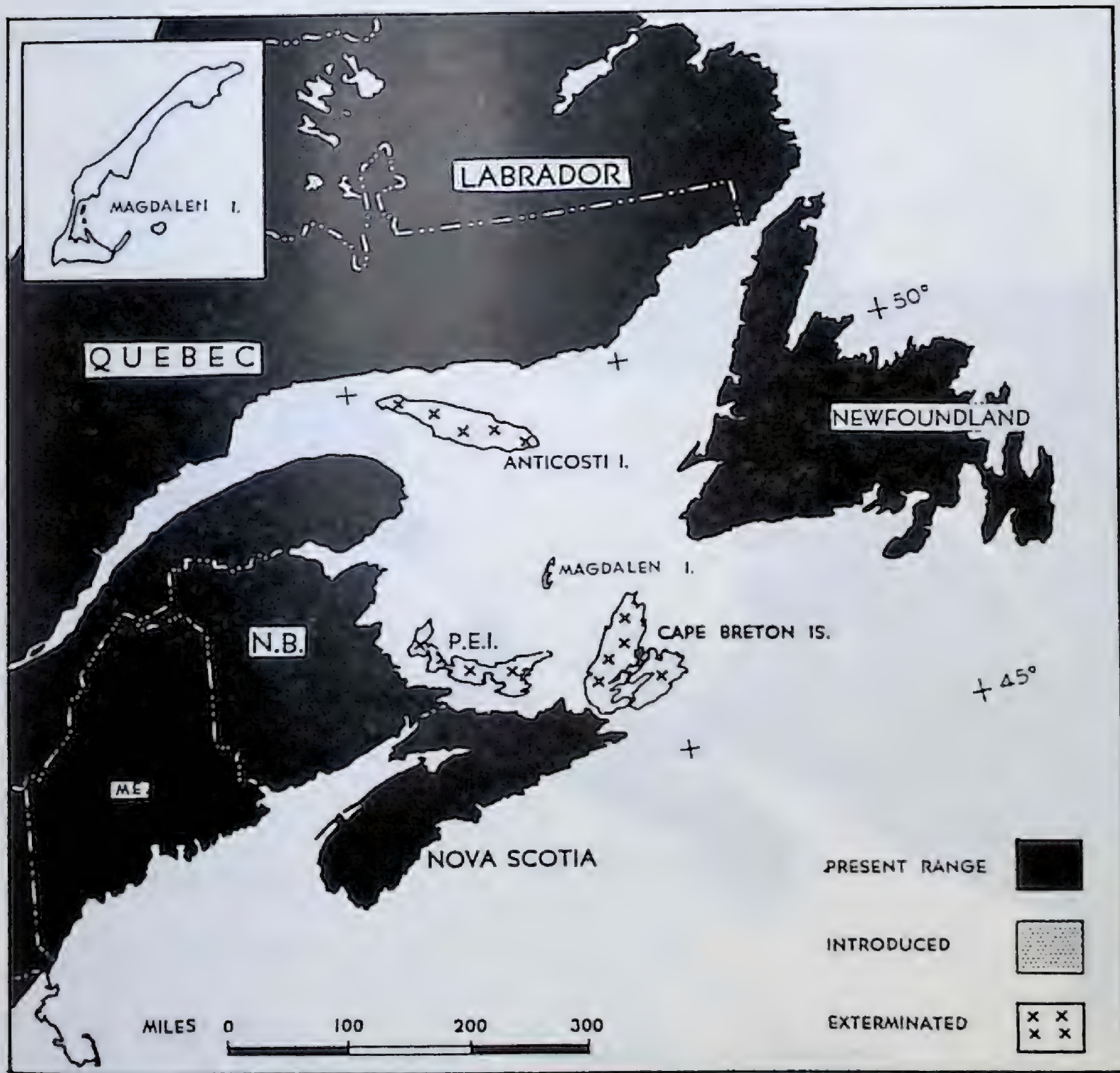
DISTRIBUTION MAP No. 18  
Black bear *Ursus americanus* (Pallas)





DISTRIBUTION MAP No. 19  
 Raccoon *Procyon lotor* (Linnaeus)





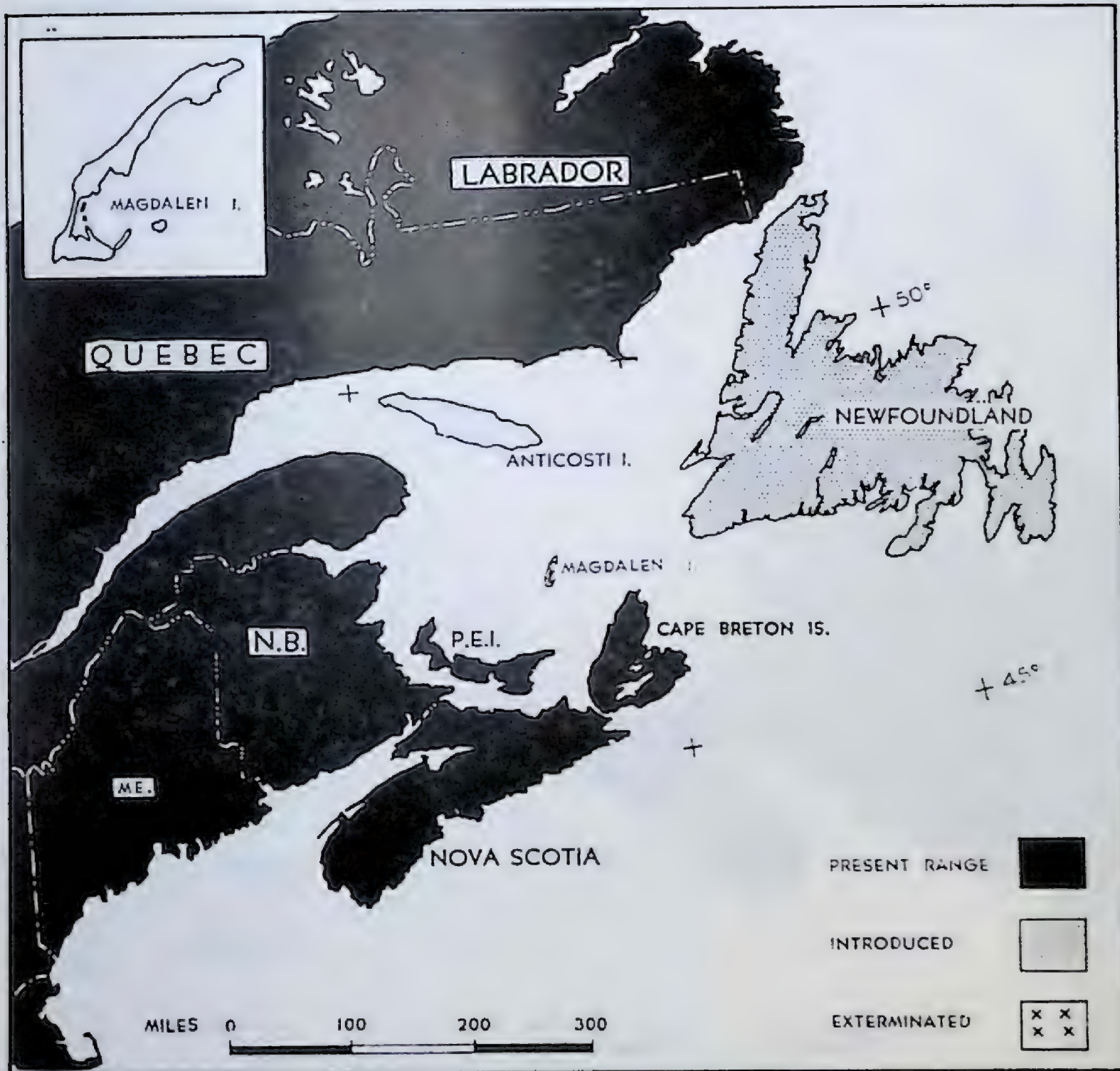
DISTRIBUTION MAP No. 20  
Pine marten *Martes americana* (Turton)





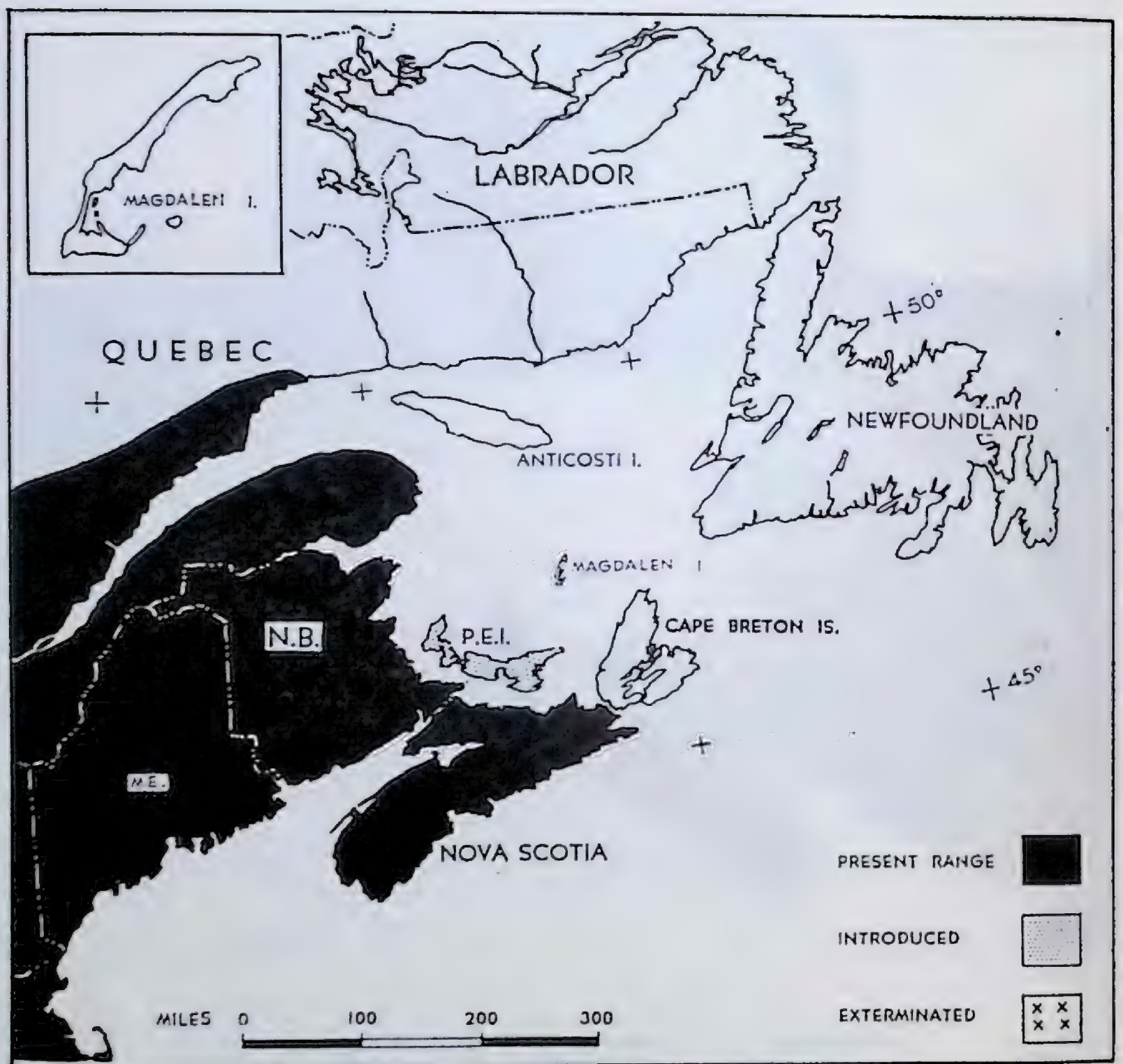
DISTRIBUTION MAP No. 21  
Ermine *Mustela erminea* (Linnaeus)





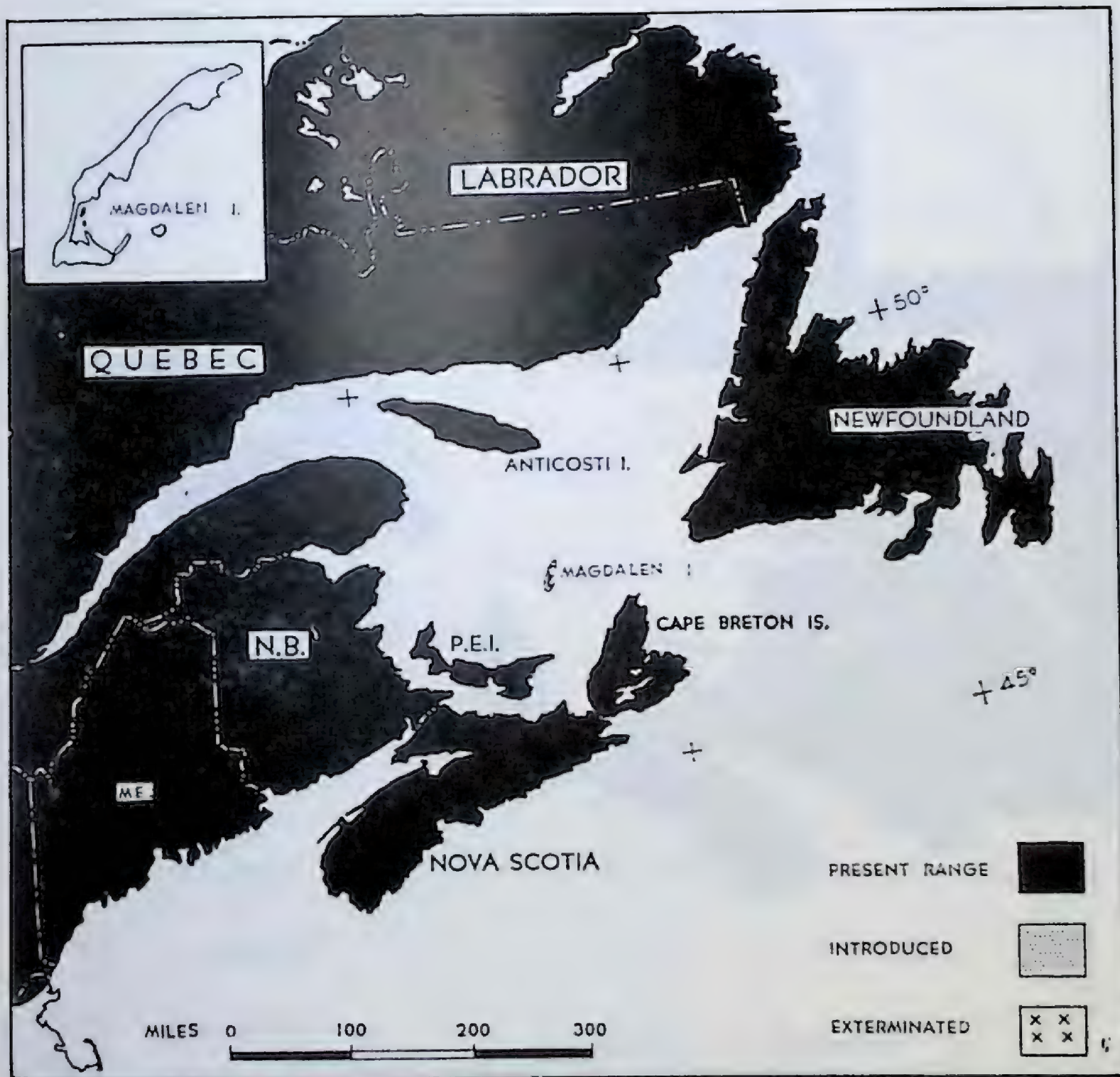
DISTRIBUTION MAP No. 22  
Mink *Mustela vison* Schreber





DISTRIBUTION MAP No. 23  
Striped skunk *Mephitis mephitis* Schreber





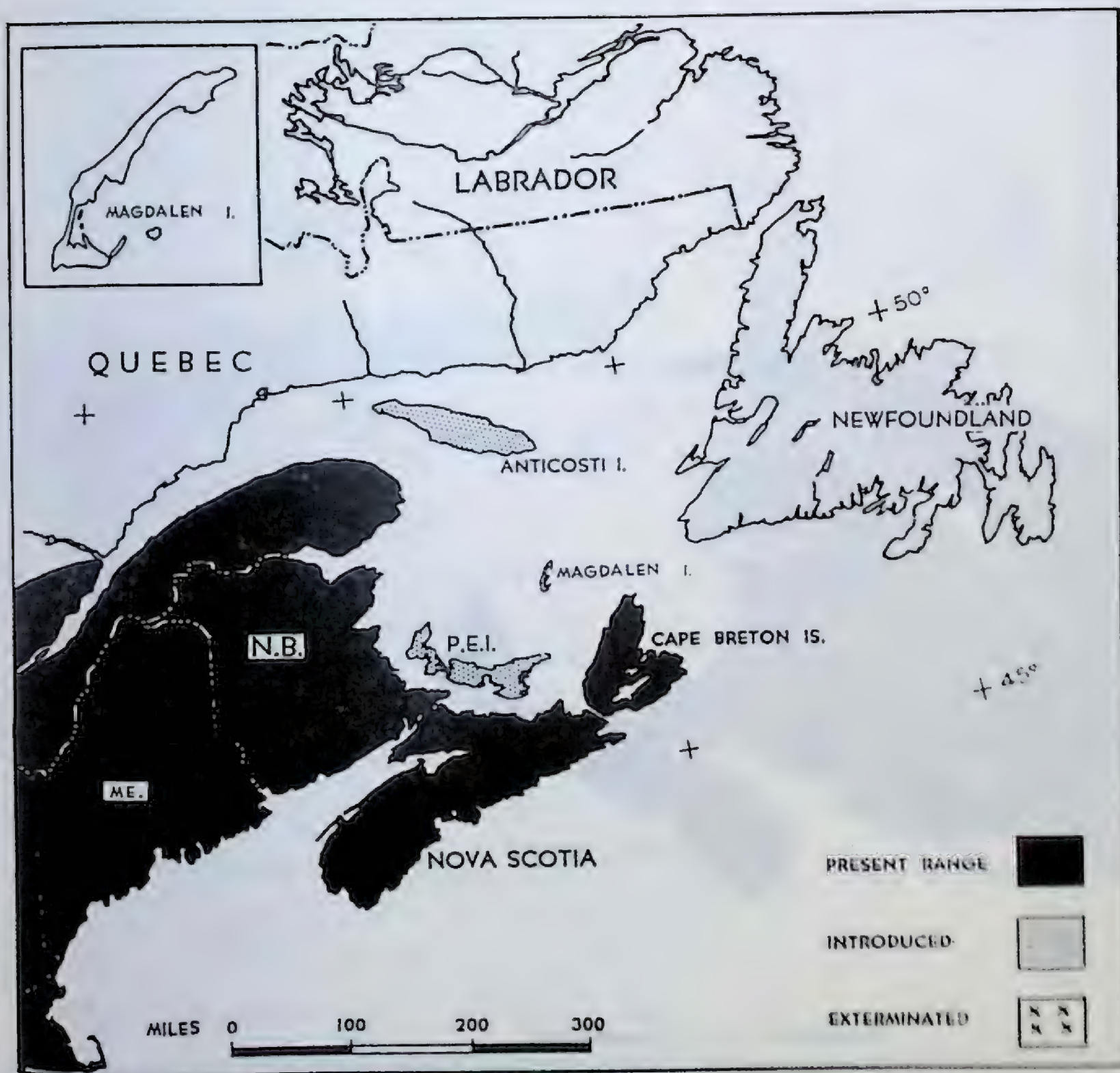
DISTRIBUTION MAP No. 24  
Otter *Lutra canadensis*





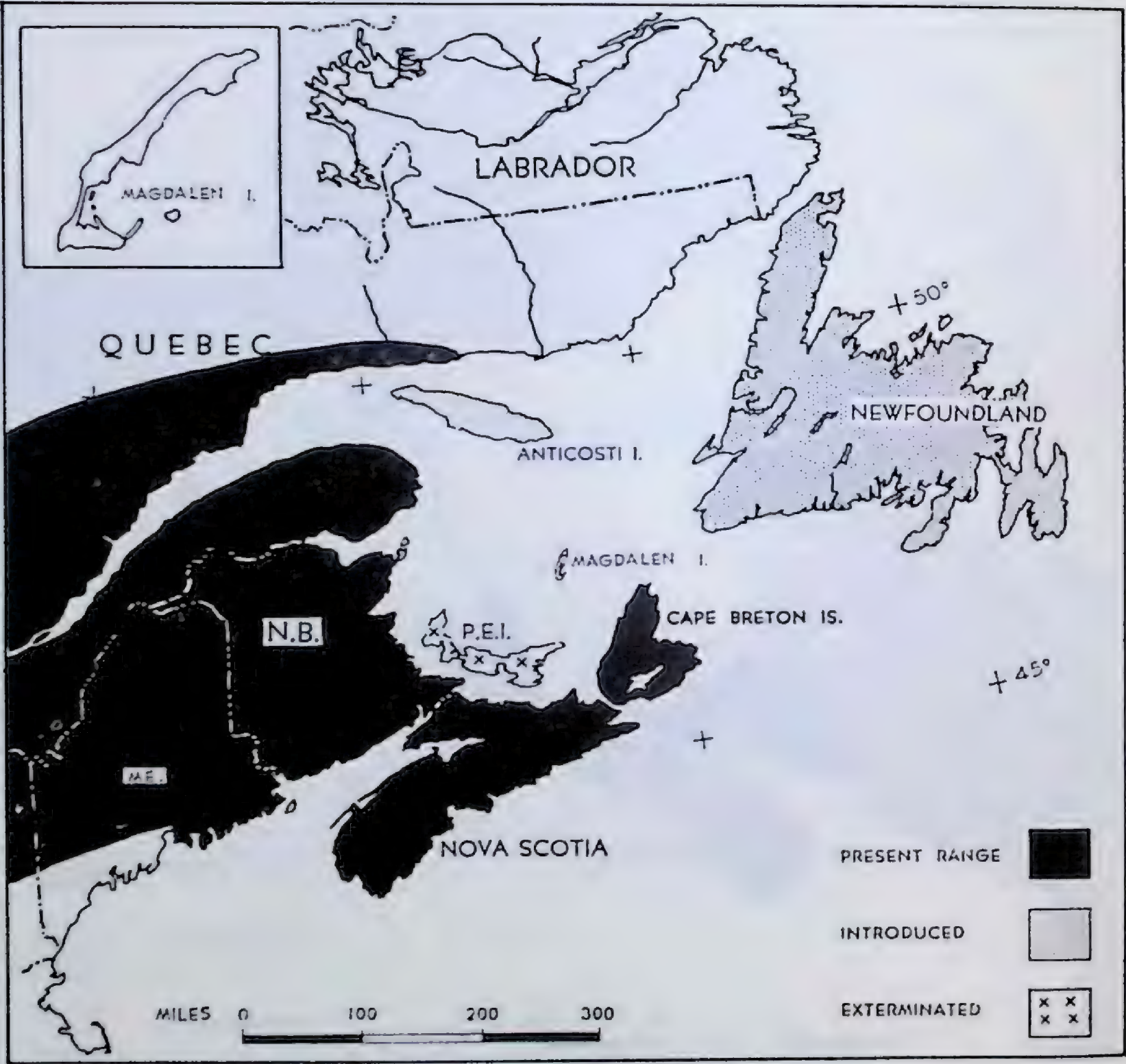
DISTRIBUTION MAP No. 25  
*Lynx Lynx canadensis* Kerr





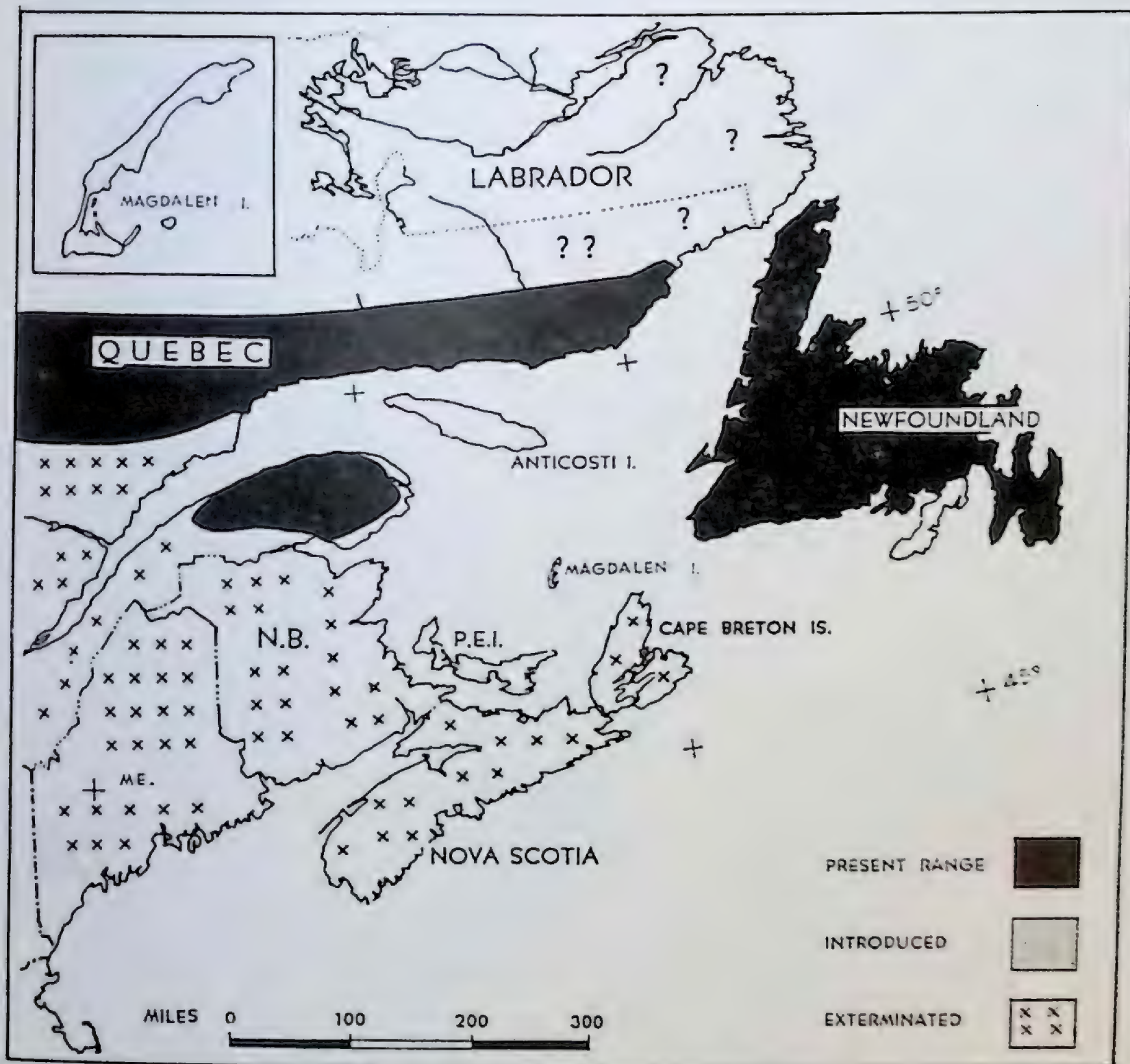
DISTRIBUTION MAP No. 26  
 White-tailed deer *Odocoileus virginianus* (Boddaert)





DISTRIBUTION MAP No. 27  
Moose *Alces alces* (Linnaeus)





DISTRIBUTION MAP No. 28  
Woodland caribou *Rangifer caribou* (Gmelin)







